A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JUNE, 1936.

GENERAL PHYSICS.

ADSORPTION.

2466. Adsorption of the Heavier Rare Gases by Mercury. H. M. Cassel and K. Neugebauer. *J. Phys. Chem.* 40. *pp.* 523–529, *April,* 1936.—The surface tension of Hg in contact with Kr and Xe is measured at several temperatures and pressures. With the accuracy available (± 0·05 dyne per cm.) the influence of A cannot be ascertained. The adsorbed quantities are calculated by means of the Gibbs equation, and the heats of adsorption derived from these isotherms are compared with the theoretical values according to the dispersion theory of the van der Waals forces. AUTHORS.

See also Abstracts 2494, 2656.

ATOMIC AND MOLECULAR STRUCTURE.

2467. Atomic Nuclei. G. Valle. *Elettrotecnica,* 23. *pp.* 94–99, *Feb.* 25; 129–135, *March* 10, *and pp.* 160–163, *March* 25, 1936.—Summary of the present state of knowledge concerning atomic nuclei. The subject is treated in sections dealing with (1) the periodic systems of the elements and the external structure of the atom, (2) isotopes, (3) matter and energy and nuclear stability, (4) natural radioactivity, (5) artificial transmutation and artificially-produced radioactive substances. F. C. C.

2468. Scattering and Absorption of Particles by Nuclei. Part I. T. Sexl. *Zeits. f. Physik,* 99. 11–12. *pp.* 751–775, 1936.—In an entirely mathematical paper the author extends his earlier work [see Abstract 2254 (1934)], in which the spin was taken as zero, and now takes account of the spin. The following are considered: (1) Free, undamped, and damped oscillations of a perturbed Coulomb field (*i.e.* radioactive decay); excited undamped oscillations of a perturbed Coulomb field (*i.e.* anomalous scattering); excited, damped oscillations of a perturbed Coulomb field (*i.e.* artificial disintegration). It is shown that the theory is applicable to α-particles, protons, neutrons and deutons. No numerical calculations are made, these being reserved for the second part of the paper. J. E. R. C.

2469. Production of Positrons from Bismuth. H. P. De. *Indian Journ. Phys.* 10. *pp.* 103–108, *March,* 1936.—A study is made of the emission of positrons from Bi with the aid of a cloud expansion chamber and stereo-camera. A block of Bi is exposed to a mixture of radiations and neutrons emitted from a tube containing a mixture of mesothorium, containing 25 % of radium, of about 10 mgm. radium activity and several mgm. of beryllium oxide. To determine the direction of ejection and nature of charge carried by the ionising particles, a thin sheet of Al is interposed inside the chamber. The result shows that for about 282 electron tracks 20 positrons are produced possessing energy ranging from $4\cdot5 \times 10^6$ to 10^5 eV. The conclusion is that the main source of positrons is the materialisation of γ-radiations. AUTHOR.

2470. Artificial Radioactivity of Tin. M. E. Nahmias. *Comptes Rendus,* 202. *pp.* 1050–1052, *March* 23, 1936.—The author describes briefly experiments which show that Sn exhibits weak artificial radioactivity after bombardment with Rn–Be neutrons, the mean decay period being about 6 min. W. E. P.

2471. Concentration of Artifically Produced Radio-Elements by Means of an Electric Field. J. W. J. Fay and F. A. Paneth. *Chem. Soc., J. pp.* 384–390, *March*, 1936.—The radioactive elements produced by the bombardment of arsine and of ethyl iodide are concentrated by submission to an electric field of about 250 V/cm. The active As isotope $^{76}_{33}$As attaches itself to positive or negative ions in the gas and can be deposited on electrodes of either sign; the I atoms, however, acquire by exchange processes the negative charge of I ions and the active $^{128}_{53}$I is collected on a Cu or Ag anode. The concentration factor in some of the experiments exceeded 20,000. F. C. C.

2472. Radioactive Argon. A. H. Snell. *Phys. Rev.* 49. *pp.* 555–560, *April* 15, 1936.—When bombarded with high speed deutons, A is found to yield a radioactive product which emits negative electrons, and decays with a period of 110 ± 1 min. Chemical tests show that the activity is due to an isotope of A, and the reaction involved is doubtless $A^{40} + H^2 = A^{41} + H^1$. Absorption measurements of the β-particles indicate that their maximum energy is about 1·1 eMV. This agrees with the results of a cloud chamber study of their distribution curve made by Kurie, Richardson and Paxton, which shows a strong group with an upper limit at 1·5 eMV, and apparently also a weak group with an upper limit at about 5 eMV. The radioactivity is accompanied by the emission of a γ-ray, the energy of which is 1·39 eMV, as measured by the energies of its Compton recoils in a cloud chamber. The excitation function of the radioactivity favours the Oppenheimer-Phillips, rather than the Gamow theory. The same radioactive substance has been made by subjecting A to an intense bombardment with neutrons. AUTHOR.

2473. Radioactive Elements of Low Atomic Number. W. A. Fowler, L. A. Delsasso and C. C. Lauritsen. *Phys. Rev.* 49. *pp.* 561–574, *April* 15, 1936.—Radioactive elements of low atomic number have been produced by the transmutation of various elements from Li to F by high velocity deutons. The distribution in energy of the electrons and positrons emitted by these elements is determined by employing a Wilson cloud chamber traversed by a magnetic field. The electron spectra found to have maximum energies from 5 to 13 eMV while the positron spectra have maximum energies from 1 to 2 eMV. The form of the spectra is found to be in agreement with a modification of the Fermi theory of β-decay proposed by Konopinski and Uhlenbeck. The correlation of the maximum energies of the spectra with the energies calculated from the reactions in which the radioactive element is involved is shown to await a more accurate determination of the difference in mass between the neutron and proton. AUTHOR.

2474. Yield of Disintegration. T. Sexl. *Phys. Zeits.* 37. *pp.* 221–222, *April* 1, 1936.—Referring to a paper by G. Stetter [see Abstract 933 (1936)] the author points out that at present the theory of disintegration by α-particles is not applicable in the region $Z = 5$ and no comparison of experiment with theory can therefore be made. W. E. P.

2475. Eighth Isotope of Molybdenum. J. de Gier and P. Zeeman. *K. Akad. Amsterdam. Proc.* 39. 3. *pp.* 327–329, 1936.—Using the carbonyl of molydenum and the same technique as previously [see Abstracts 4765 (1935) and 370 (1936)], an eighth isotope of Mo, of mass 102 is found. This and other results agree better with theoretical deductions of Sitte than those of Mattauch. F. C. C.

***2476. Deuterium Content of Hydrogen Mixtures by Thermal-Conductivity Method. K. Wirtz.** *Zeits. f. phys. Chem.* 32. *Abt. B.* 4. *pp.* 334–340, 1936.—The author discusses some inherent difficulties of the Farkas method [see Abstract 1775 (1934)] together with the possibility of their removal. It is shown in detail how the apparatus may be simplified in several respects, and thereby rendered more serviceable. H. H. Ho.

2477. Absorption of Neutrons Detected by Boron and Lithium. D. P. Mitchell. *Phys. Rev.* 49. *pp.* 453–458, *March* 15, 1936.—The paper gives the variation of the neutron-nuclear collision cross-sections of various elements for neutrons that are detected by means of the B and Li neutron-capture reactions and that are strongly absorbed by Cd. Investigations of the neutron-nuclear interaction in some representative elements for neutrons not strongly absorbed by Cd are also dealt with. W. E. P.

2478. Neutron Capture and Nuclear Structure. N. Bohr. *Naturwiss.* 24. *pp.* 241–245, *April* 17, 1936.—Many of the experimental facts concerning the entrance of neutrons into the nucleus may be explained on the supposition that a metastable nucleus results, the life of which is long compared with the reciprocal of the frequency of γ-rays emitted in the process. For the emission of heavy particles, the metastable state is still formed; the energy of the bombarded nucleus is initially divided approximately equally between the heavy particles constituting the nucleus but ultimately, by exchange processes, one particle acquires sufficient energy to escape. F. C. C.

2479. Collisions of Slow Neutrons with Protons. V. I. Mamasachlisov. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 198–209, 1936. *In German.*—In this theoretical paper it is suggested that there are small repulsive forces between a proton and a neutron in addition to the forces of attraction which are operative at very small distances. Consideration of Majorana exchange forces indicates that for neutrons in the bound state the potential hill corresponding to these repulsive forces is transformed into a potential valley, within which is a P-level. The absorption of slow neutrons by protons is considered as a dipole-transition $S \rightarrow P$ of the usual type. The radius ($2\cdot 6 \times 10^{-12}$cm. approximately) and height ($2\cdot 3 \times 10^{6}$ eV approximately) are chosen so as to accord with experimental data. L. A. W.

2480. Action of Photo-Neutrons on Silver through a Layer of Copper, Lead or Beryllium. A. Leipunsky and L. Rosenkewitsch. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 275–278, 1936. *In English.*—It is shown that photo-neutrons obtained by the action of Ra γ-rays on Be are retarded on passing through Cu and Be. AUTHORS.

2481. Quantum Characteristics of Valency Electrons. B. Ormont. *Acta Physicochimica,* 4. 3. *pp.* 409–440, 1936. *In German.*—The significance of the quantum characteristics of valency electrons in the discussion of the melting points and lattice structure of the elements is discussed. J. S. G. T.

2482. Theory of Metallic Bond. Part I. P. Gombás. *Zeits. f. Physik,* 99. 11–12. *pp.* 729–742, 1936.—In earlier publications [see Abstract 3782 (1935)] it was shown by means of a model representing combination in metals that a metallic state for solid H_2 did not exist. From further consideration of this model, the most important constants of metallic K have been utilised to determine the electronic distribution of the ions. The following results are given respectively for the lattice constant, lattice energy, heat of sublimation, and compressibility : $\delta_0 = 5{\cdot}37$ Å, U = 111·1 k.cal./mol., S = 11·4 k.cal./mol., $k = 2{\cdot}6 \times 10^{-11}$ cm.^{2}/dyne, which compared with the corresponding experimental data : $\delta_0 = 5{\cdot}15$ Å, U = 126·2 k.cal./mol., S = 26·5 k.cal./mol., $k = 2{\cdot}0 \times 10^{-11}$ cm.^{2}/dyne, shows very satisfactory agreement. No empirical or semi-empirical parameters are introduced into the calculations. An appendix contains simple evaluations of the ionic energy term and of the integrals employed from the Hartree tables. H. H. Ho.

2483. Binding Energies of Molecular Compounds. G. Briegleb and J. Kambeitz. *Zeits. f. phys. Chem.* 32. *Abt.B.* 4. *pp.* 305–333, 1936. —The authors have investigated the binding energies of molecular compounds of symmetrical trinitrobenzene. They first discuss the optical method employed for solutions and then describe copious experimental details of their measurements which were undertaken in chloroform solution. A theoretical part deals with the experimental data, and interprets the mechanism of the partial valency forces, the sections being devoted to *p*- and *σ*- electrons, the configuration of the molecular compounds, the bonding mechanism of polar components to the phenyl nucleus, disturbance-spreading effect for conjugation, for disruption of conjugation, for trivalent unions, and for long chains. Although phenyl- and diphenyl compounds are principally concerned in this investigation, the results are shown to be of importance for problems of catalysis and of reaction mechanism. H. H. Ho.

2484. Hydrogen Bond between Oxygen Atoms in Organic Compounds. G. E. Hilbert, O. R. Wulf, S. B. Hendricks and U. Liddel. *Am. Chem. Soc., J.* 58. *pp.* 548–555, *April,* 1936.—Infra-red absorption characteristic of hydroxyl groups has been measured quantitatively for a number of selected alcohols and phenols. Since the absence of characteristic OH absorption is found to be closely correlated with the presence of the H bond as indicated by evidence from other sources, it has been inductively concluded that the absence of such OH absorption constitutes a good criterion for the presence of a H bond. In the present work this method is used for testing various factors believed to influence the formation of a H bond between O atoms. AUTHORS.

2485. Structural Chemistry. N. V. Sidgwick. *Chem. Soc., J. pp.* 533–538, *April,* 1936.—In this Presidential Address for 1936 to the Chemical Society, the author has chosen for his subject the development of structural chemistry from its origin to the present time. The structural theory was laid down in the 50's and 60's of last century mainly through the work of Kekulé and Cannizzaro and extended to three dimensions by van't Hoff and le Bel in 1874. Since then only a few minor developments have been introduced, such as the recognition of the distinction between ionised and non-ionised links, and of the coordinate or semipolar bond. The position of the structural theory is peculiar both in its extent and in its limitations ; in predicting the number of isomeric forms that can exist it is infallible, and wherever a new form can be obtained, there is a new formula ready for it ; on the other hand the theory gives a very limited representation of the properties of the linked atoms, and in particular of the reactivity. The complete calculation of properties by wave mechanics is not yet possible except for a few of the simplest molecules, but by a variety of approximations a picture of the mechanism by which the atoms are held together in a molecule can be obtained. Both the theoretical and experimental evidence indicate two factors in the formation of a molecule, viz., the simple linkage between the atoms and the further influence of the remaining atoms on the linkage. The former determines the individuality of the compound and the latter its reactivity. The principle of resonance, which constitutes the most important development of structural chemistry since the days of van't Hoff, is then described in great detail and in such clear and simple language as to make the address of the utmost value to all interested in structural chemistry. H. H. Ho.

2486. Structure of Nitromethane by Electron Diffraction. C. Degard. *Comptes Rendus*, 202. *pp.* 1278–1280, *April* 6, 1936.—A series of photographs is made with waves of wave-lengths 0·0585, 0·0644, and 0·0837 Å, and two diffraction maxima are obtained. Two models are calculated for the interatomic distances, which are stated as follows: C–N (1·34 ± 0·05, 1·53); N–O (1·15 ± 0·02, 1·13): O–O (1·18 ± 0·08, 1·96); α (106° ± 4°, 119° ± 4°). The distance O–O does not correspond to the sum of the atomic or ionic rays, but in the first model it is relatively near to that in the molecule O_2 (1·204). From the Raman spectra of NO_2, $\alpha = 103°$ or 108° (calculated from valency and central forces respectively). The same method used for the molecule NO gives the interatomic distance as 1·146. The data should be useful for the study of nitro-derivatives. H. H. Ho.

2487. Atomic Weight of Carbon. G. P. Baxter and A. H. Hale. *Am. Chem. Soc., J.* 58. *pp.* 510–515, *March*, 1936.—In view of recent isotopic and other indications that the atomic weight 12 is too low, the C : O ratio is determined gravimetrically by the combustion of certain aromatic hydrocarbons of high molecular weight containing only a small % of H. The substances used are pyrene $C_{16} H_{10}$, chrysene $C_{18} H_{12}$, triphenylbenzene $C_{24} H_{18}$, and anthracene $C_{14} H_{10}$; these are burned in pure O_2 and the CO_2 and H_2O formed are collected and weighed. Excluding results for pyrene which could not be completely purified, the average of a large number of analyses gives the value 12·009 for the atomic weight of C; this is identical with Aston's latest value corrected for the abundance ratio of C^{13} (1 : 140), packing fraction 4×10^{-4}, and conversion factor 1·00025. N. M. B.

2488. Sixth Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, O. Hönigschmid and P. Lebeau. *Am. Chem. Soc., J.* 58. *pp.* 541–548, *April*, 1936.—Three changes are proposed [see Abstract 2798 (1935)]: Ta from 181·4 to 180·88, Ra from 225·97 to 226·05, and the insertion of Pa 231. Results discussed but not held as yet to justify change are for C, tending to change the atomic weight to 12·01, and for K to 39·1, of Te to 127·63, of Tb to 158·89 which would agree with Aston's finding that Tb is a simple element of atomic weight 158·91, and of Eu to 152·30 (Aston finds 151·9). Redeterminations of Cr and As confirm the present values. Aston's results from packing fractions and abundance ratios [see Abstract 1904 (1935)] confirm the figures for C, Ca, Ti, Fe, Ni, Ga, Zr, Ag, In and Hf, but give 112·2 for Cd, while by comparison of doublets he obtained for H 1·0081, D 2·0148, He 4·0041 and C 12·0048 or 12·0012. C. A. S.

2489. Molecular Constants of Thallium and Tellurium Halides. W. Grether. *Ann. d. Physik*, 26. 1. *pp.* 1–16, *May*, 1936.—Halide vapours are obtained from 0·5–1 gm. of substance placed in a hard glass tube enclosed in a copper sheath electrically heated. A beam of electrons from a hot kathode tube, passing through a water-cooled earthed anode with two stops of 1 mm. dia., passes through the vapour stream at right angles. To avoid degradation of the vacuum the halides are rapidly condensed either with liquid air or CO_2 snow. Exposure is usually ½–2 sec., sometimes as long as 15 sec., and the apparatus works with 1 mA, at 50 kV., with a 0·05 μF condenser. Visual observation of the rings with a screen can be carried out for as long as 5 min. without difficulty. Mean values of l found in Å are Tl Cl, 2·55 ± 0·03; Tl Br, 2·68 ± 0·03; Tl I, 2·87 ± 0·03; in good agreement with previous values; $TeCl_2$, 2·36 ± 0·03; $TeBr_2$, 2·49 ± 0·03. It is not certain whether the triatomic molecules have absolutely straight chains, but the angle of departure cannot exceed 30°. D. R. H.

See also Abstracts 2501, 2505, 2516, 2655, 2665, 2666, 2668, 2677, 2701, 2715, 2716, 2717, 2724, 2730, 2739, 2740, 2744, 2747, 2748, 2758, 2765, 2823, 2845, 2885, 2888.

COLLOIDS.

2490. Colloidal Solutions in Concentrated Electrolytes. A. Voet. *J. Phys. Chem.* 40. *pp.* 307–315, *March*, 1936.—A colloidal solution may be stable in solutions of concentrated electrolytes. Methods of preparation are described for sols of metals, sulphides, silver halides, sulphur, carbon, etc., in dispersion media such as concentrated sulphuric acid and phosphoric acid and saturated solutions of salts, such as calcium chloride and potassium acetate. Sols in solutions of concentrated electrolytes do not show any electrokinetic p. d., nor an increase in relative viscosity. Some colloids in concentrated electrolytes exhibit thixotropy. The hypothesis that the stability of colloidal systems in concentrated electrolytes is caused by solvation is supported by several arguments. AUTHOR.

2491. Constitution of Iron Oxide Sols. W. Heller, O. Kratky and H. Nowotny. *Comptes Rendus*, 202. *pp.* 1171–1173, *March* 30, 1936.—This paper is a preliminary report on a combined magneto-optic and X-ray study of 40 sols of various characteristics, including those containing chlorine, prepared by decomposing $FeCl_3$ in various ways. J. K.

2492. Spontaneous Structure Formation of $Fe(OH)_3$ Sols. G. Fuchs and A. Rabinerson. *Acta Physicochimica*, 4. 3. *pp.* 441–452, 1936. *In German.*—Previous work [see Abstract 423 (1934)] has indicated that structure formation in $Fe(OH)_3$-sols also takes place in the absence of coagulating electrolytes. It is now shown that the temporary changes of conductivity and H-ion concentration of different $Fe(OH)_3$-sols indicates that the gradual hydrolysis of the ferric salts in the intermicellar liquid of freshly prepared sols at first increases, and after a certain period (3 to 6 days), which is the more prolonged the higher the colloid content, comes to a standstill. The spontaneous coagulation structure formation in $Fe(OH)_3$-sols is explained as the result of hydrolysis, which signifies decrease of ferric-ion concentration in the intermicellar liquid with accompanying desorption and gradual coagulation. Although hydrolysis comes to a standstill in the course of time so that no further decrease in charge takes place, the coagulation process is ever progressive and its velocity depends on the magnitude of the adjusted constant ζ-potential. H. H. Ho.

2493. Mixtures of Colloidal Electrolytes with Uni-Univalent Salts. J. W. McBain and Janet Searles. *J. Phys. Chem.* 40. *pp.* 493–499, *April*, 1936.—Mixtures of ordinary electrolytes with ordinary alkali soaps or with hydrogen soaps, like mixtures of sodium chloride with sodium salts of organic acids, exhibit conductivities and freezing point lowerings in substantial agreement with the simple additive mixture rules. In all these cases, the charges on the polyvalent ion or micelle are spaced so far apart as to be effectively independent. Hence the ionic strength of colloidal electrolytes resembles that for a uni-univalent electrolyte. AUTHORS.

2494. Kinetic Theory of Ionic Exchange. Part I. H. Jenny. *J. Phys. Chem.* 40. *pp.* 501–517, *April,* 1936.—A simple model of the mechanism of ionic exchange is proposed. With the aid of the model an exchange adsorption isotherm is theoretically deduced. The equation can be verified for colloidal clay systems over a considerable range of concentration. Certain systems are but poorly governed by the equation. This particular behaviour is explained on the basis of structural peculiarities of the colloidal particles and extreme variations of the properties of the participating ions. The third root of the base exchange constant is shown to be equal to the ratio of the electric potentials of the double layers. This relationship directly connects ionic exchange with problems of colloid stability. AUTHOR.

2495. Observation of Gelation. T. Fujiwara and T. Hudita. *Hiroshima Journ. Sci.* 6. *pp.* 239–243, *March,* 1936. *In English.*—The influence of stirring the sol during the period of transformation into gel is studied in relation to the physical properties of the latter. For high concentrations a new method is devised involving a determination of the hardness of the gel formed. Differing degrees of hardness of the same gel concentration are secured merely by cessation of the stirring at different temperatures and different stages of gelation. Hardness decreases rapidly from 31° C. and at 25° C. becomes almost constant. If stirring is stopped when the gel is only partly formed the broken up particles of gel will be bound together by the gel subsequently formed into one mass. The hardness thus depends on the proportion of non-gelatinised sol remaining when stirring is stopped. Water evaporation from gels formed by continuous stirring throughout formation is 7 % higher in rate than from non-stirred gel. S. G. B.

2496. Pressed Foam Gelatin. S. E. Sheppard and J. H. Hudson. *Indust. and Engin. Chem.* 28. *pp.* 422–423, *April,* 1936.—Describes briefly a new method of preparing gelatin so that it will absorb and dissolve in water with the maximum rapidity and will not be excessively bulky. The gelatin liquor is passed, with an air lift, through a baffle-type emulsator and thence on to a chill roll so that the foam structure is set. It is then air-dried and finally compressed, the sheets of compressed foam gelatin consisting chiefly of compressed cells of the original foam and partly of shattered cells. The specific gravity is usually between 0·2 and 0·3, but sheets of this material are no more bulky than other forms of gelatin preparations. Finally, data regarding water absorption and the rate of solution are given. R. C. F.

2497. Bound Water in Gelatin Gel. E. Hatschek. *Faraday Soc., Trans.* 32. *pp.* 787–789, *May,* 1936.—Gelatin gels containing $CoCl_2$ are shown to contain from 30 to 34 % of bound water incapable of hydrating the cobalt salt, a value in good agreement with the figures for bound water found by other methods. AUTHOR.

2498. Swelling of Caoutchouc in Solvent Mixtures. N. Jermolenko and S. Lewina. *Kolloid Zeits.* 75. *pp.* 59–65, *April,* 1936.—The behaviour of vulcanised caoutchouc is investigated in various solvents, and the swelling found to exhibit a regular dependence on the polarisation of the swelling medium. The swelling curve in mixtures of two apolar solvents runs parallel with the polarisation (P_{12}) curve. In mixtures of two solvents where the apolar component influences the polarisation of the polar component, the swelling curve alters in the opposite direction to the change of the P_{12}-curve; a mixture of benzene and alcohol deviates from the latter regularity. In the system benzene-chloroform the swelling curve runs parallel to the P_{12}-curve, but an intermediate position is given by the system benzene-toluene. In ternary solvent mixtures, the inactive but polar ethyl alcohol, when added to a mixture of benzene and chloroform, strongly increases the swelling of the caoutchouc. The zone with the minimum degree of swelling occupies the smallest surface in the Gibbs triangle which proceeds from the component with the greatest polarisation (ethyl alcohol). H. H. Ho.

2499. Formation of Liesegang Rings in the Presence of Precipitates. B. N. Sen. *J. Phys. Chem.* 40. *pp.* 369–372, *March*, 1936.—The formation of Liesegang rings of Prussian blue in the bodies of calcium sulphate and barium sulphate, moistened with ferric chloride solution, is recorded. The influence of the concentration of the ferric chloride on the characteristics of the rings is studied. AUTHOR.

2500. Solution of Film-Forming Substances. J. Scheiber and O. Baier. *Kolloid-Beihefte*, 43. 9–11. *pp.* 363–416, 1936.—It is stated that the most varied film-forming substances show within limits of concentration, of practical importance, solution characteristics which can be considered to be at least approximately normal. It follows from this that film-forming substances, which show typical colloidal properties, give rise to no difficulties upon increase in concentration beyond the critical limit, except that there is a normal reformation of the solid colloidal end-products, *i.e.*, as long as the increase in concentration takes place in motionless thin layers. Disturbances in film formation are to be expected in those systems wherein the critical concentration has already been exceeded in the phase of mechanical preparation. Colophony solutions can be considered viscometrically normal at concentrations up to 70 %, while the concentration limit for manilla-copal is 40 %. On the other hand phenol-formaldehyde resins show generally a normal viscosity relationship. Solutions of resins with equipolar components can be recognised, because the substitution of a solvent, such as alcohol, by a non-solvent, *e.g.*, toluol, leads to a proportionate increase in viscosity, while for solutions of resins with non-equipolar components there is, at least at first, a drop in viscosity. It is thus easy to distinguish viscometrically phenol-formaldehyde basic or acid condensation products from the corresponding cresol-formaldehyde resins. In agreement with the results of Staudinger it is shown that the viscosity of rubber solutions is considerably lowered on passing chlorine through them. Prior depolymerisation with stannic chloride leads to a still greater decrease in viscosity. Viscosity measurements are also given for solutions of vinyl acetate polymerisation products, nitrocellulose, and polystyrol. J. K.

2501. Micellar Structure as Related to Cellulose. J. W. McBain and D. A. Scott. *Indust. and Engin. Chem.* 28. *pp.* 470–473, *April*, 1936.—Micellar structure and association are discussed with reference to viscosity. From experiments on nitrocotton, which are described, it is concluded that cellulose derivatives are association colloids and that association and formation of micelles is one of their characteristics.

Staudinger's extrapolation method for determination of molecular weights from viscosity is criticised on the grounds of over simplification. C. B. A.

2502. Experimental Investigation of Laminar Systems. S. G. Mokruschin, R. B. Ginsburg and N. M. Demjanowa. *Kolloid Zeits.* 75. *pp.* 10–14, *April*, 1936.—Skins of bismuth and lead sulphides were formed by the action of H_2S on surfaces of bismuth nitrate solutions and lead acetate solutions respectively. The maximum thickness of the skins was 1500 to 2000 Å, 20 times thicker than those of similarly formed copper sulphide skins [see Abstract 1466 (1935)]. Both the lower and the upper surfaces are strongly hydrophobic. The upper surface is mirror-like, and the lower is matt. The skins seem to possess a crystalline structure. The colours of the lead films of different thicknesses when viewed by reflected and transmitted light are in general agreement with Brückmann's results. P. H. B.

See also Abstracts 2508, 2534, 2695, 2807, 2918.

CRYSTAL STRUCTURE AND PROPERTIES.

2503. External Form of Crystals and Interference Phenomena in Space Lattices. M. v. Laue. *Ann d. Physik.* 26. 1. *pp.* 55–68, *May*, 1936.—Previous work has occasionally dealt with grain size; the present theme is a discussion of grain form. The question is of importance in observations by electronic diffraction. F. I. G. R.

2504. Energy Levels of Electrons in a Single-Dimensional Crystal Model Containing Cavities. A. Sokolow and N. Machalowa. *Zeits. f. Physik*, 99. 7–8. *pp.* 503–517, 1936.—The behaviour of electrons is studied in a single dimensional crystal model, containing cavities (*Lockerstellen*). The influence of the cavities on " zone-forming " levels and the conditions for the occurrence of new levels in " forbidden " intervals are investigated mathematically. The results of the theory are applied to explain certain properties of the crystal which are related to its conductivity; in particular an attempt is made to explain the electrical breakdown of dielectrics by use of Wilson's theory. A. M. T.

2505. Polar Isomorphism. A. E. Fersman. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 3. *pp.* 119–122, 1936. *In English.*—The conditions governing the accumulation of kations (A, of radius R_A and valency V_A) present in dilute solution, in the lattice of a second substance B (ionic radius R_B, valency V_B) present in larger amount and precipitated from the solution, depend on the identity (or near identity) of R_A and R_B, and of V_A and V_B, though V_A may be $>$ V_B if Ra is $>$ $(\ngtr 15\ \%)$ R_B. The solution need not be saturated with A. It has been shown by Goldschmidt and Hahn that a gain in energy occurs when an ion of greater V enters a lattice, and that this occurs in the precipitation of A (of greater V) together with B when the two form mixed crystals. These facts and actual data regarding co-precipitation, and the energy coefficients, EK [see Abstract 18 (1936)] show that kations A will only be taken into the lattice containing B if the EK of A is $>$ that of B, and so increase the energy and stability of the lattice. The importance of the above as regards separation of minerals in veins, etc., is stressed. C. A. S.

2506. Structure of Silver Phosphate. L. Helmholz. *J. Chem. Phys.* 4. *pp.* 316–322, *May*, 1936.—A new value for the O parameter in the structure of silver phosphate is determined which gives the P – O separation in the phosphate group as 1·61 Å ± 0·03 Å. The value found here is slightly larger than that determined from an analysis of the crystal

KH_2PO_4. The slight increase in P – O distance is explained on the basis of the nature of the phosphate group and of some covalent bond formation between O and the surrounding Ag atoms. To get qualitative agreement between calculated and observed intensities it is found necessary to treat the Ag atoms as oscillators with tetragonal symmetry, the symmetry of their environments in the crystal. The ratio of the amplitudes of vibration along the tetragonal axis and perpendicular to it is evaluated from the data. This result is discussed in relation to the structure of AgI. AUTHOR.

2507. Calcium Sulphate Hemihydrate and the Anhydrites. Part I—Crystallography. W. A. Caspari. *Roy. Soc., Proc.* 155*A. pp.* 41–48, *May* 18, 1936.—The preparation, properties and morphology of single crystals of calcium sulphate hemihydrate are described. X-ray analysis of the crystal gives the probable (trigonal) space-group and arrangement of ions in the lattice. The structure so formed leaves channels between Ca^{++} and CO_3^{--} ions, along which H_2O molecules can circulate. Dehydration of calcium sulphate hemihydrate under conditions short of conversion into anhydrite causes slight mechanical changes in the crystal but leaves the lattice unaltered. It is shown by X-ray spectrography that the dihydrate (gypsum) and hemihydrate yield the same substance under the above conditions, and it is concluded that there is only one crystal species intermediate between anhydrite and dihydrate. AUTHOR.

2508. X-Ray Studies of Crystallite Orientation in Cellulose Fibres. Part II. W. A. Sisson. *J. Phys. Chem.* 40. *pp.* 343–359, *March,* 1936. *Paper read before the Amer. Chem. Soc., April,* 1935.—During the preparation of synthetic fibres from bacterial cellulose membranes certain interesting observations were made regarding the plastic behaviour of the crystallite in elucidation of its nature, and the study of the type and degree relationship between deformation and orientation. The experimental results show that the major factor in regard to the latter is the relative direction and extent of the flow, or change in dimensions of the sample rather than the nature, magnitude, or direction of the forces producing the flow. If the sample is elongated in one direction, the *b*-axes of the crystallites are oriented parallel to that direction; if the sample is constricted in one direction the (101) planes are oriented normal to that direction. This general rule apparently applies to both mercerised and unmercerised membranes, regardless of whether changes in dimensions are produced by shrinkage or by plastic flow due to mechanical force. A similar rule is applicable to plastic flow of metals. Cell distortion alone does not explain the orientation effects since the orienting tendency of cellulose appears to be a fundamental property of both native and regenerated cellulose derivatives (in the regenerated type no cell structure is assumed). The present results emphasise that whatever the final concept of the membrane crystallite may be, this concept must realise that the crystallite possesses a major orienting tendency with reference to the *b*-axis, and a minor or selective orienting tendency with reference to the (101) plane. [For Part I see Abstract 962 (1935).] S. G. B.

2509. Structure of Tooth Enamel. J. Thewlis. *Brit. J. of Radiology,* 9. *pp.* 300–312, *May,* 1936.—X-ray examination of tooth enamel has shown that the apatite crystals, of which the enamel is composed, are preferentially oriented. The crystals are so arranged that their hexagonal axes tend to be parallel to the same direction—the fibre-axis. In dogs' teeth the fibre-axis is at right-angles to the tooth surface. In human teeth the fibre-axis can occupy one or both of two positions, *i.e.*,

the enamel can show single or double orientation. The first position is almost always predominant. In some cases the fibre-axis is found to be tilted out of the plane of the tooth section. Three classes of enamel have been recognised, the classification being based on variations in degree and amount of preferential orientation. It is suggested that the occurrence of double or single orientation and of the various classes of enamel is due to variations in the conditions under which the apatite crystals are laid down, and not to environmental conditions present after eruption.
AUTHOR.

2510. Structure of Liquids. Part I. K. Herrmann. *Die Physik*, 4. 2. *pp.* 63–76, 1936.—A general review of the subject indicated by the title, divided into four main sections :—(1) Determination of fine structure of condensed amorphous phases by means of X-rays. (2) Determinations without X-rays. (3) Liquid crystals. (4) Molecular arrangement of liquid-crystal surfaces.
F. I. G. R.

2511. Influence of Symmetry of Medium on Symmetry of Corrosion Figures on Crystals. L. Royer. *Comptes Rendus*, 202. *pp.* 1346–1348, *April* 15, 1936.—The effect of active organic acids (tartaric and malic) on various hemihedral crystals, sphalerite, zincite, scolecite, cuprite, apatite, scheelite and wulfenite, is examined. With all except apatite and wulfenite the results are only indefinite striae, but with these two the corrosion figures formed by the active, differ definitely from those formed by the inactive isomers. The sensitive faces are those which have as sole elements of symmetry a plane of symmetry normal to their direction, *e.g.*, the prism faces of apatite. In other cases the dissymmetry is only apparent on comparing a face and its parallel, *e.g.*, the two base faces of wulfenite.
C. A. S.

2512. Distribution of Impurities during Crystallisation. D. D. Saratovkin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences*, 4. 8–9. *pp.* 323–326, 1935. *In German.*—The author discusses the distribution of impurities (which do not form mixed crystals) during the crystallisation process, and based on the considerations advanced he explains the following well-known phenomena : Decreasing compactness (formation of cavities in slowly melting crystals), Widmannstetten structures, etching figures produced by acids on metallic surfaces, and dendritic crystallisation.
H. H. Ho.

2513. Recrystallisation of Cu-Rich α-Brass. A. Kitaigorodski. *Techn. Phys., U.S.S.R.* 3. 1. *pp.* 39–50, 1936. *In German.*—Alloys up to 7 % Zn are prepared by melting together Cu and Zn, (*a*) in purified N_2, (*b*) under charcoal in air, with subsequent deoxidation. Recrystallisation is determined on a 97–98 % cold-worked strip by an X-ray method. At about 2 % Zn the rate is a minimum as shown both by time and by temperature curves. The speed is not affected by 0·2–0·4 % P nor by Cu_2O which markedly inhibits recrystallisation in pure Cu. Apparently the oxide is immediately reduced by Zn. Theoretically, recrystallisation depends on nuclei number and rate of growth so that it is unnecessary to assume the formation of a special constituent at 2 % Zn. Theoretical investigation of recrystallisation is very difficult. The practical rule (recrystallisation temp./m.pt.) = const. has no theoretical or experimental basis for the alloys investigated.
D. R. H.

***2514. Guide for Crystal Drawing. W. M. McNabb and Josephine W. McNabb.** *Frank. Inst., J.* 221. *pp.* 539–546, *April*, 1936. A guide, for student use, is presented for the drawing of a crystal using the gnomonic projection. For artificial crystals, about 0·1 to 1 mm. in dia., it is recommended that a camera lucida drawing of the top and bottom of the crystal be made, and that this be used as a basis for the orthogonal plan. Using this method, an accurate picture of the typical crystal can be obtained. For an ideal crystal the drawing is made to correspond to the symmetry of the crystal system. AUTHORS.

2515. Elastic Constants of Single Crystals of Copper, Gold and Lead. E. Goens with J. Weerts. *Phys. Zeits.* 37. *pp.* 321–326, *May* 1, 1936.—In these three cubic metals the fundamental elastic constants are obtained by analysis of the elastic properties of a series of single crystals, in relation to the crystal orientation. Values deduced are—

	S_{11}	S_{12}	S_{44}
Copper	14·91	− 6·25	13·28
(Kimura's values)	12·91	− 5·23	16·36
Gold	23·3	−10·65	23·8
(Röhl's values) ...	22·7	−10·35	22·9
(Goens' values) ...	24·5	−11·3	25·0
Lead (no previous values)	93·0	−42·6	69·4

D. R. H.

See also Abstracts 2481, 2482, 2572, 2667, 2715, 2771, 2784, 2797, 2834, 2866.

DENSITY.

2516. Density Difference Between Sea Water and Fresh Water. K. Neumann and G. Tohmfor. *Zeits. f. phys. Chem.* 176. *Abt.A.* 3. *pp.* 226–228, 1936.—Regarding fresh water as derived from sea water by isothermal distillation, a difference of density is to be expected on account of the different vapour pressures of the water species containing different isotopes. An approximate calculation gives a difference of $4 \cdot 3 \times 10^{-6}$ between the densities of sea water and the first fraction obtained by isothermal distillation, whereas the author obtains by a simple float method a difference of $2 \cdot 9 \times 10^{-6}$ between sea water and fresh water. L. A. W.

See also Abstract 2884.

DIFFUSION AND OSMOSIS.

2517. Diffusibility of Deuterium in Metals. T. Franzini. *N. Cimento*, 13. *pp.* 74–78, *Feb.*, 1936.—Experiments are made to determine whether deuterium diffuses through metals, Pd being used as it is known that H_2 is occluded by this metal. The presence of H_2 and D_2 is determined spectroscopically. The work shows that occluded H_2 is removed by an electric field, but no evidence for this is obtained in the case of D_2. C. J. B. C.

2518. Diffusion of Gases through Metals. Part III. Degassing of Ni and the Diffusion of CO through Ni. C. J. Smithells and C. E. Ransley. *Roy. Soc., Proc.* 155*A*. *pp.* 195–212, *May* 18, 1936.—The problem discussed is the extraction of gas from commercial Ni by heating *in vacuo* or H_2. The first part states the facts concerning the amount and the nature of the gases evolved from Ni at various temperatures. Apart from easily detachable surface gas, the gas evolved is mainly CO. In the second part the rate of diffusion of CO is measured. The measured rate is far too small to account for the rate at which gas is evolved from the metal in the usual degassing processes. Consequently the hypothesis is proposed that the CO is generated from C and O_2, not combined with each other, contained in the metal. In the third part, measurements are made of the diffusion of C and O_2 through Ni with a view to testing the hypothesis. It is found that both C and O_2 do diffuse through Ni and that if both are diffusing at the same time CO is given off. It seems certain that the CO evolved in normal degassing arises in this way; it is likely that the rate of evolution is controlled by the rate of diffusion of the C. But since the rate of diffusion of O_2 is much less than that of C it is not obvious why the diffusion of C, rather than that of O_2, is the controlling factor. An explanation is attempted, but the matter is not completely explained. [For Part II see Abstract 4829 (1935).] AUTHORS.

See also Abstracts 2788, 2820.

ELASTICITY AND PLASTICITY.

2519. Elastic Plane Problem and Its Interpretation in Space. G. Supino. *Accad. Lincei, Atti*, 22. *pp.* 522–528, *Dec.* 1, *and pp.* 581–585, *Dec.* 15, 1935.—The author discusses the limits of validity of solutions for the stresses in an elastic plane as average solutions of three-dimensional problems. A necessary and sufficient condition is established that the components of tension in the solution of the plane problem shall equal the average values of these tensions through the thickness of the plate in the problem of a thick plate unloaded on its basal surfaces and subjected to forces on the generators of its boundary symmetrical with respect to the medial plane. This condition is not satisfied when the forces are constant on the generators. W. S. S.

2520. Impact of Two Material Bodies. P. Regnauld. *Comptes Rendus*, 202. *pp.* 1365–1366, *April* 20, 1936.—Mathematical results relating to the following problems of impact are presented : (1) the impact of two cylindrical masses having the same mechanical and physical characteristics ; (2) the impact of a deformable projectile against an indeformable plane ; (3) the impact of a steam-hammer upon a body resting upon an indeformable support. J. S. G. T.

2521. Bending and Stretching of Square Plates. R. Kaiser. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp.* 73–98, *April*, 1936.—An attempt is made to supply data which are required in the study of the bending of plates under maximum conditions of flexure. A very thin square plate, freely suspended and with a uniformly distributed load, is considered and the strains set up in such a plate and the alterations in shape which occur as a result are investigated experimentally. The results are compared with those deduced from theory. Section I is devoted to a description of a series of measurements on a steel plate. Theory and experiment show that the region of greatest strain does not occur at the centre of the plate but in a ring shaped zone some distance from the centre. Good agreement is found between theory and experiment, especially in the middle portion of the plate ; small deviations at the edges of the plate are accounted for by edge effects which cannot be satisfactorily taken into account in the theoretical calculations. H. J. H. S.

2522. Bending of Rectangular Plates. J. C. Costello. *Phil. Mag.* 21. *pp.* 1005–1007, *May*, 1936.—Bateman's solution of the problem of flexure of a rectangular plate, loaded uniformly, and supported by a large number of rigid pillars marking out rectangular panels, the pillars being joined by beams which afford a flexible support to the edges [see Abstract 4461 (1935)], is found by the present author only to be correct to the first approximation. The corrected form is given. The paper is entirely mathematical. H. H. Ho.

***2523. Elastic Measurements with Coupled Pendulums. P. Cicala.** *Ricerche di Ingegneria,* 4. *pp.* 1–8, *Jan.–Feb.,* 1936.—Besides the usual direct methods of measuring the deformability of any structure, there exists an indirect procedure, in which two pendulums are attached to the structure. When one pendulum is set oscillating, the motion of the other is excited through the medium of the elastic system, and the oscillations of both pendulums presents the phenomenon of beats. The measure of the periods of the beats gives a determination of the deformability of the elastic structure. The present paper examines in particular the application of this method to the determination of the torsional and flexural rigidity of a beam. The effect of the inertia of the structure and also of the internal friction is analysed. A. J. McC.

2524. Apparent Volumes and Compressibilities of Solutes in Solution. Part III. A. F. Scott and G. L. Bridger. *J. Phys. Chem.* 40. *pp.* 461–469, *April,* 1936.—Measurements of the densities and compressibility coefficients of both unsaturated and supersaturated solutions of calcium nitrate are made at 35° C. The effect of concentration on the apparent molal volume and compressibility of the solute is discussed. It is found that neither the empirical relationship of Masson nor the theoretical relationship of Redlich and Rosenfeld is applicable to these solutions. [For Part II see Abstract 4837 (1935).] AUTHORS.

2525. Latent Energy and Residual Stress in Plastically-Deformed Rock-Salt. A. I. Garber. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 111–131, 1936. *In German.*—It is shown experimentally that the residual stress energy of plastically strained rock-salt is considerably less than the latent energy of the crystal. J. S. G. T.

2526. Two-Dimensional Theory of Flexural Oscillations of a Ring of Rectangular Cross-Section. K. Federhofer. *Akad. Wiss. Wien, Ber.* 144. 2*a.* 9–10. *pp.* 561–575, 1935.—The author has previously discussed the one-dimensional flexural oscillations of a thin ring [see Abstract 4840 (1935)]. The analysis is now extended to obtain the complete solution of the flexural oscillations of a ring of finite rectangular cross-section. The results are applied to improve deductions contained in the former paper. J. S. G. T.

2527. Vibrations of Elastic Strings. R. Höger. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 109–116, *April,* 1936.—The motion of a heavy elastic string which hangs between two fixed points at the same level and is allowed to make small oscillations of a general character, is studied. The equations of motion are solved and the normal modes of vibration determined. G. C. McV.

2528. Oscillatory Motion of a Loaded Helical Spring. S. Higuchi, T. Tomita and M. Kashiwagi. *Frank. Inst., J.* 221. *pp.* 621–633, *May,* 1936.—The equivalent mass of a loaded helical spring (k) which is used in the equation of motion of a spring vibrating under simple harmonic conditions is usually taken as $1/3\ m$ (m = mass of spring). It is assumed that this mass is concentrated at the centre of the attached load (M) and that M is greater than m. A series of measurements of the natural frequency and damping factors of springs of steel and brass is carried out, from which it is concluded that the usual conventional equation of motion of a helical spring may be used regardless of the pitch of its winding, that the value of 1/3 m for the equivalent mass of the spring is a limiting value of the case when M/m approaches zero. A method is given for deriving theoretically the value of k corresponding to any value of M/m. H. J. H. S.

2529. Fatigue of Metals. H. J. Gough and W. A. Wood. *Roy. Soc., Proc.* 154*A. pp.* 510–539, *May* 1, 1936.—The paper describes an investigation of the failure of metals by fatigue, in which X-ray diffraction methods are used to examine the changes produced in the crystal structure of a normalised mild steel (0·1 % C), which is subjected to various types of fatigue tests and to static stresses. Failure is characterised by changes which include (i) a dislocation of the normally perfect grains into components which vary in tilt up to about 2° from the orientation of the perfect grain; (ii) the formation of crystallites, approximately 10^{-4} to 10^{-5} cm. in size, exhibiting a much wider divergence in orientation than the parts of a dislocated grain; and (iii) lattice distortion in the crystallites. For static stresses, these effects appear abruptly at the yield point and progressively become more marked as the stress is increased to the value at which fracture occurs. For repeated cycles of a range of stress the same progression of changes in structure takes place, the changes being most marked at the point in the specimen where fracture commences. The crystal structure of a specimen subjected to repeated cycles of a range of stress less than the range necessary to produce fracture exhibits no appreciable progressive change after any initial change which may occur on first application of the load; the structure tends to a steady state as the number of cycles is increased. The conditions giving rise to a marked initial change are those where the superior stress of the cycle exceeds the static yield point of the material. W. E. P.

2530. Effect of Width on the Breaking Strength of Sheet Glass. A. J. Holland and W. E. S. Turner. *Soc. Glass Technol., J.* 20. *pp.* 72–83, *April*, 1936.—A detailed study in the previous paper [see Abstract 4843 (1934)] of the effect of width on the modulus of rupture of strips of 26 oz. sheet glass varying from approximately 0·4 to 1·2 cm. in width, the sides of the strips being in different cases (*a*) ground and mechanically polished, (*b*) ground and mechanically polished followed by fire polishing, (*c*) cut with the diamond and tested with the residual flaws in tension. Progressive increase in the modulus of rupture is found with diminution in width. For fire finished strips of 0·395 cm. width, values as high as nearly 1700 kg./cm^2. are obtained, the mean being 1299. The Karmarsch equation relating the strength (F) of metallic wires to their diameter d, namely, $F = a + (b/a)$, where a and b are constants, applies equally well to the results in which d is regarded as the width of the specimen. From Griffith's modified equation, values for the "ultimate strength" of glass are calculated. Straight fractures are consistently obtained for widths of 0·7 cm. (and, in general, below 0·8 cm.) when the sides are not fire polished. In the latter condition more complex fractures are either usual or at least frequent even for specimens of 0·4 cm. width.
AUTHORS.

***2531. Micromanometer. H. W. Smith.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 151–152, *March* 15, 1936.—The instrument is essentially a sensitive U-tube having a large reservoir communicating with a glass tube of dia. 0·25 in., a rubber connection being used to give the necessary flexibility. The reading arm is at a small angle to the horizontal to give sensitivity. In use the reading arm is raised by means of a micrometer screw until the meniscus is restored to a definite position. The liquid is methyl alcohol, which does not attack rubber and has a known specific gravity. G. E. B.

See also Abstracts 2803, 2890.

GRAVITATION.

2532. Gravitational Force. P. Drumaux. *Ann. Soc. Sci. de Bruxelles,* 56. *pp.* 5–14, *April* 3, 1936.—The author discusses the different expressions for the velocity and acceleration of a test particle in the Schwarzschild field according as different definitions of distance are adopted. He is concerned to reject one of the definitions which leads to the conclusion that a particle with a sufficiently high velocity would be repelled from the central massive body, instead of attracted to it.
G. C. McV.

2533. Quantum Theory of Weak Gravitational Fields. M. Bronstein. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 140–157, 1936. *In German.*—A quantical-mechanical continuous system, of which the classical equations of motion can be written in the form $\Box h_{\mu\nu} = 0$ is discussed. The treatment is, to some extent, analogous with the Fermi method of quantisation of the electromagnetic field. J. S. G. T.

2534. Thermodynamic Equilibrium in the Gravitational Field. F. O. Koenig. *J. Phys. Chem.* 40. *pp.* 373–378, *March,* 1936.—The fundamental equations for the thermodynamics of the gravitational field are written in a form more general than hitherto by the inclusion of the gravitational potential ϕ as an independent variable. The theoretical interest of the resulting new equations is briefly pointed out, and their practical usefulness shown by deducing from them the known laws of hydrostatic equilibrium and sedimentation equilibrium. The latter law is expressed in a new and compact form involving the activity coefficient.
AUTHOR.

See also Abstracts 2556, 2557, 2558, 2559, 2624, 2625, 2628.

HYDRODYNAMICS AND AERODYNAMICS.

2535. Motion of Air Past Obstacles. D. P. Banerjee. *Indian Phys. Math. J.* 7. *pp.* 1–9, *March,* 1936.

2536. General Equations of Turbulence. F. Odone. *Accad. Lincei, Atti,* 22. *pp.* 506–512, *Dec.* 1, 1935.—The equations of turbulence proposed by Mattioli [see Abstract 445 (1936)] have two defects: there are more equations than there are unknowns, and moreover for the non-turbulent motion of a viscous fluid the equations do not reduce those of classical hydrodynamics. A slight modification of Mattioli's equations are here proposed, which avoids these defects. A. J. McC.

2537. Excitation of Surface Waves by Oscillating Bodies. M. Schuler. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 65–72, *April,* 1936. —A body (M) partly immersed in liquid and suspended by a flexible spring, executes vertical oscillations, thus causing surface waves to be propagated on the surface of the liquid. When the amplitude and frequency of oscillation of M are comparatively small the waves are progressive in character; with large amplitudes and frequencies, stationary waves are obtained. The case of the production of progressive waves is here examined practically and theoretically. J. S. G. T.

2538. Vibration of an Infinite Elliptic Cylinder in a Viscous Liquid. M. Ray. *Zeits. f. angew. Math. u. Mechanik,* 16. *pp.* 99–108, *April,* 1936.—For small values of a characteristic constant analogous to Reynolds' number, the case of an elliptic cylinder can be successfully treated by using Stokes' stream function, which is found to give results for a circular cylinder very quickly. The elliptic cylinder ultimately leads to Mathieu equations and the first approximation suffices to get the necessary fit at the boundary. W. A. R.

2539. Gliding of a Plate on the Surface of a Stream. A. E. Green. *Cambridge Phil. Soc., Proc.* 32. *pp.* 248–252, *May,* 1936.—The two-dimensional gliding of a plane plate on a stream of infinite depth is discussed mathematically. A complete solution for any angle of incidence of the plate on the stream is given, the results being expressed in terms of the length of the plate. The motion is supposed to be steady and gravity is neglected. The plate is taken as at rest, and the stream impinges on it so that it leaves the trailing edge smoothly and forms a spray at the leading edge. The solution is obtained by means of the Schwarz-Christoffel transformation. In Wagner's solution, the lift increases linearly with the spray thickness, δ; in the present solution as δ increases from 0 to ∞, the lift increases to a maximum and then decreases to the finite limiting value of the classical Rayleigh flow. [See Abstract 1021 (1936).]
J. S. G. T.

2540. Thermal Limiting Layer. G. Kroujiline. *Techn. Phys., U.S.S.R.* 3. 2. *pp.* 183–194, 1936. *In French.*—The approximate mathematical theory of heat transfer between a solid and a fluid is treated along the lines of the limiting layer used by Prandtl and Kármán, for the case in which the flow in the layer is laminar in character.
J. S. G. T.

2541. Flat Plate Problem of Skin Friction and Heat Transfer. N. A. V. Piercy and J. H. Preston. *Phil. Mag.* 21. *pp.* 995–1005, *May,* 1936.—The authors obtain a new solution of the flat plate problem of skin friction and heat transfer under steady conditions at large Reynolds numbers. The method employed is one of successive approximation, and the several results of the past 35 years, on which the theory of the subject rests, are reproduced as steps. In contrast with earlier investigations, the analysis is throughout simple and the need of computation slight. With no numerical work at all it is possible to attain within 3 % of the final results of either more exact analysis or mean experiment. It is anticipated that the method will serve other purposes in hydrodynamics. While generalised theory is not discussed, convergence is shown to be so rapid in the present application that the sixth approximation approaches the correct analytical result within 0·25 %. H. H. Ho.

2542. Friction Factor of Fluids in Pipes. E. C. Koo. *Chem. Eng. China, J.* 3. *pp.* 3–14, *March,* 1936. *In English.*—From data of reliable nature on the friction factor in turbulent flow, it is concluded that the general index law equation ($f = a + b/\mathrm{Re}^c$) should be used to express the relation between fanning friction factor, f, and Reynolds number, Re. Two new empirical equations of this form are proposed; one for smooth pipes, such as copper, brass, glass and lead, and the other for commercial iron and steel pipes, *viz.*, $f = 0{\cdot}00140 + 0{\cdot}125/\mathrm{Re}^{0\cdot32}$ (for smooth pipes), and $f = 0{\cdot}00307 + 0{\cdot}189/\mathrm{Re}^{0\cdot38}$ (for commercial pipes). They are recommended to be used for almost any size of pipes, and for any kind of fluid, whether it is a gas or liquid. In respect of the friction factor equations, a brief explanation on the mechanism of isothermal flow in fluids is attempted. AUTHOR.

See also Abstracts 2531, 2534, 2783.

KINETIC THEORY OF MATTER.

2543. Influence of the Electric Field on Hydrogen Atoms in Atomic Ray Investigations. H. Scheffers and J. Stark. *Phys. Zeits.* 37. *pp.* 217–220, *April* 1, 1936. *From the Reichsanstalt.*—In a previous investigation [see Abstract 4319 (1934)] it was found that in the atoms of an atomic ray the electric field gave rise to a proportional moment and the factors of proportionality, a, for Cs, K and Li were measured to be $4\cdot2 \times 10^{-23}$, $3\cdot4 \times 10^{-23}$ and $1\cdot2 \times 10^{-23}$ respectively. The investigation is now extended to H atoms the factor of proportionality in this case being $0\cdot03 \times 10^{-23}$. [See following Abstract.] J. E. K.

2544. Evaluation of Atomic Ray Experiments in an Electric Field. H. Scheffers. *Phys. Zeits.* 37. *pp.* 220–221, *April* 1, 1936.—This article comprises a collection of the formulæ used in the experiments on atomic rays in the electric field of a cylindrical condenser [see preceding Abstract]. J. E. K.

2545. Relativistic Degenerate Gas and its Application to Brownian Motion. M. Satô. *Tôhoku Univ., Sci. Reports,* 24. *pp.* 565–586, *Feb.,* 1936. *In German.*—It is shown, starting from Glaser's theory of a relativistic degenerate corpuscle-gas, that light- and gas-pressure can be analysed mathematically on similar lines. For the motion of molecules in a radiation field it is shown that the mobility of the molecules is inversely proportional to the fourth power of the absolute temperature. G. C. McV.

See also Abstracts 2494, 2701, 2787, 2797, 2824, 2826.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***2546. Automatic Mercury Pipette. P. H. Bigg.** *Journ. Sci. Instruments,* 13. *pp.* 156–157, *May,* 1936.—The pipette is made of glass and is filled with mercury by operating one stopcock and emptied by operating a second stopcock. The flow of mercury ceases automatically when filling is complete and also when delivery is complete. The design of the apparatus prevents the trapping of air bubbles at the stopcocks. The pipette described delivers 0·3125 ml. within ± 0·003 ml. Pipettes of other capacities can be constructed on the same principles. AUTHOR.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

2547. Empirical Formulæ. C. Sunatani. *Tohoku Univ., Technol. Reports,* 12. 1. *pp.* 1–27, 1936. *In English.*—It is shown that the method of least squares is not based on Gauss' law of error as is usually supposed. The method is regarded as a particular case of the method of least m-th powers and it is argued that the best approximation is determined when $m = 1$ (" method of least differences "). A graphical method of solution applicable to a general case and to any value of m is given. The algebraical solution by the method of least differences is generally impossible unless the formulæ are very simple, but a greater number of problems can be solved algebraically by least squares. The methods of least differences and of least squares can be used for the expansion of a single-valued function and affords a series having a higher degree of approximation than Taylor's method, a series of orthogonal functions, or a series derived from an integral equation. Numerical examples illustrating various points in the paper are given. P. H. B.

2548. Computation of Complete Elliptic Integrals. F. Emde. *Arch. f. Elektrot.* 30. *pp.* 243–250, *April* 18, 1936.—In the applications of elliptic integrals to electromagnetism, interpolation is simplified by using tables of new integrals $D = (K\text{-}E)/k^2$, $B = K - D$, and $C = (D-B)/k^2$, instead of tables of K and E. Tables of D, B and C to argument k^2 are given. When k is nearly unity, it is better to split C and D into a logarithmic part, which is read from tables of logarithms, and new functions c and d, for which interpolation is linear. These functions are also tabulated. P. V.

2549. Extension of Heaviside's Operational Calculus. J. R. Carson. *Bell System Techn. J.* 15. *pp.* 340–342, *April*, 1936.—An exposition of van der Pol's generalisation [see Abstract 3618 (1929)], for a system of a finite number of degrees of freedom, followed by an application to the differential equations of the transmission line. While stated in the language of electric circuit theory, the processes are generally applicable to a wide variety of problems.

2550. Lamé's Equation. J. L. Sharma. *Phil. Mag.* 21. *pp.* 991–994, *May*, 1936.—Solutions $F_n(u)$ of Lamé's differential equation have been given by Halphen, where F involves the Weierstrass σ and ξ functions. It is now shown that, like the customary solutions, these functions are orthogonal, *i.e.*, $\int \wp(u)F_n(u)F_m(u)du = 0$ when $m \neq n$ and $\wp(u)$ is Weierstrass' elliptic function. This property is utilised to expand functions of u in series of $F_n(u)$ functions. R. W. P.

2551. Absolute Systems of Units. F. Odone. *Accad. Lincei, Atti*, 22. *pp.* 513–517, *Dec.* 1, 1935.—An absolute system of units is described in which length is the sole fundamental quantity. The units of mass and time are defined to make the gravitational constant and the velocity of light equal to unity. The dimensions (all powers of L) of the dynamical, electrostatic and electromagnetic magnitudes in this system are tabulated and the numerical values of their new units in terms of c.g.s., e.s. and e.m. units are calculated taking the unit of length to be 1 cm. W. S. S.

2552. Absolute Electrical Units. R. T. Glazebrook. *Phys. Soc., Proc.* 48. *pp.* 444–451, *May* 1, 1936.—Summarises the relation between the electrostatic, electromagnetic, and Gaussian systems of absolute units, and also the more recent decisions concerning electrical units, made by the international committees of the Bureau of Weights and Measures, the International Electrotechnical Commission, and the International Union of Pure and Applied Physics. L. H.

2553. Fourth Unit of the Giorgi System. R. T. Glazebrook. *Phys. Soc., Proc.* 48. *pp.* 452–455, *May* 1, 1936.—The practical problems of electrical standardisation are concerned with the numerical values of the coefficients in the classical electromagnetic equations. The question, which of the electrical units should be regarded as fundamental in the Giorgi system, is concerned only with dimensions of units, and has no necessary connection with the practical construction of standards. L. H.

2554. Fundamental Units of the Giorgi System. L. Roy. *Comptes Rendus*, 202. *pp.* 1232–1234, *April* 6, 1936. *R.G.E.* 39. *pp.* 747–753, *May* 23, 1936.—The Giorgi system of units may be regarded as one of a family of Maxwellian electromagnetic systems. Three fundamental units, those of length (M), mass (K), and time (S), are therefore sufficient, and there is no need to define a fourth. It would be possible to dispense with the unit of mass by adopting an idea of Maxwell and defining mass in terms of the acceleration produced in one particle by the presence of a neighbouring particle, thereby deriving the unit of mass from those of length and time. L. H.

2555. Systems of Units. G. Vallauri. *Elettrotecnica*, **23.** *pp.* 182–189, *April* 10, 1936.—The author criticises the recent proposals of the I.E.C. with regard to the C.G.S. system of units. He strongly recommends the use of the "classic" system, "rationalised" in accordance with Giorgi's suggestions. The principles involved are fully explained, and comparative tables showing the effect of rationalisation are given. R. G. J.

See also Abstracts 2913, 2914.

MECHANICS, CLASSICAL.

See Abstracts 2520, 2562, 2587, 2588.

MECHANICS, QUANTUM.

2556. Projective Wave Geometry. H. Takeno. *Hiroshima Journ. Sci.* 6. *pp.* 147–172, *March*, 1936. *In English.*—A geometry is constructed by applying the principle of linearisation [see Abstract 1985 (1935)] to Veblen's projective relativity, and by using the method of Morinaga's wave geometry [see Abstract 4485 (1935)]. Veblen's metric is first expressed in terms of wave geometry, and from an examination of coordinate and spinor transformations is obtained the most general transformations which make $\gamma_a X^a \psi = 0$ invariant; the gauge transformation of γ's does not appear, but that of x^0 appears instead; thus is obtained the same transformations as in ordinary spinor calculus. Consideration of parallel displacements of $\gamma_a X^a \psi$ leads to the equation $V_\mu \psi = R_\mu \psi$, which is taken as the fundamental equation for ψ in this geometry, and is invariant for all the transformations obtained above. The condition for integrability of the fundamental equation is found, and leads to a fundamental projective tensor equation which is then expressed in contracted and affine form containing tensors interpreted as the electromagnetic-energy, charge and currect vector and energy tensors. Hence is obtained the Einstein and de Sitter law of gravitation with cosmological constant. N. M. B.

2557. Complete and Simpler Treatment of Wave Geometry. T. Sibata and K. Morinaga. *Hiroshima Journ. Sci.* 6. *pp.* 173–189, *March*, 1936. *In English.*—In a former paper [see Abstract 4485 (1935)], the expression for the metric in general microscopic space was defined by $ds\psi = dx^i \gamma_i \psi$, and the transformations and parallel displacement which make $ds\psi = 0$ invariant were investigated. In this paper the parallel displacements and the differential equations for ψ obtained by this parallelism are considered through the relation of the differential and fundamental equations for ψ and the conditions for integrability of these equations. The condition in the case of the fundamental equation is expressed by the original Morinaga equation, the general solutions of which are deduced. [See following Abstract.] N. M. B.

2558. Some Solutions of $\frac{\sqrt{\Delta}}{2}\epsilon_{stpq} K_{lm}{}^{\cdot\cdot pq} = K_{lmst}$. K. Morinaga and H. Takeno. *Hiroshima Journ. Sci.* 6. *pp.* 191–201, *March*, 1936. *In English.*—Since the general solutions found for this equation [see preceding Abstract] are not yet directly applicable to the physical standpoint, this problem is investigated by finding some approximate solutions and then proceeding to the finite solutions [see Abstract 4486 (1935)]. The solutions considered are the orthogonal one and the one in which the coordinate system is chosen so that one of the congruences (taken as time coordinate) and the parametric curves may be orthogonal to the others. Some properties of the solutions are examined. [See following Abstract.] N. M. B.

2559. Microscopic Field Theory. Y. Mimura. *Hiroshima Journ. Sci.* 6. *pp.* 203–215, *March*, 1936. *In English.*—Further consideration shows that the proposition in a previous paper [see Abstract 4487 (1935)], that the Morinaga equation is the macroscopic gravitational law, must be abandoned, and the assumption that the principle of equivalence holds even in microscopic physical phenomena is avoided in favour of constructing the microscopic field theory on the basis of the extended wave geometry without adhering to the principle of equivalence. Taking the fundamental equations of this wave geometry as those of the new theory, the latter is developed with reference to the smallest elementary particle and the gravitational wave. [See preceding Abstract.] N. M. B.

2560. Wave Mechanics. J. Géhéniau. *J. de Physique et le Radium*, 7. *pp.* 181–186, *April*, 1936.—It cannot be assumed from the general theory of relativity that the metric space in which physical phenomena take place is identical with the Minkowski pseudo-Euclidean space. Hence the theory of wave mechanics is developed as fully as possible in a completely invariant form. The laws of conservation of electricity and impulse of energy are simply developed, as well as the theorem of equivalence between the variational principle and the principle of operators. A relativistic theory of the electron or positron is presented as a generalisation of the theory of an electron without spin. N. M. B.

2561. Polarisation of Dirac Electron Waves. J. Winter. *Comptes Rendus*, 202. *pp.* 1265–1267, *April* 6, 1936.—The theory of a plane monochromatic electron wave, governed by Dirac's equations, which is scattered by a spherical region of constant potential is worked out. It is proved that such a wave will not be polarised by double scattering, in accordance with the experimental results. G. C. McV.

See also Abstracts 2485, 2533, 2590, 2744, 2745, 2746, 2839, 2840, 2841, 2860.

RELATIVITY AND ETHER.

2562. Equations of Dynamics Deduced from the Principle of Special Relativity. E. Esclangon. *Comptes Rendus*, 202. *pp.* 1353–1356, *April* 20, 1936.—Further discussion of the author's formulæ for accelerated motions whose equations are invariant under Lorentz transformations [see Abstract 2020 (1936)]. G. C. McV.

2563. Concealed Systems and Relativity. R. C. Colwell. *Phil. Mag.* 21. *pp.* 976–980, *May*, 1936.—An analogy is drawn between Maxwell's concealed mechanical system from which ropes, which may be pulled, hang, and the mechanism of the Michelson-Morley experiment. The significance of the energy equation $E = mc^2$ is discussed and it is pointed out that the apparent increase of mass with increase of velocity is due, not to an increase in the number of electrons, protons, etc., but to a change in the units of length and time. J. S. G. T.

2564. New Theory of Relativity. S. C. Damle. *Nat. Acad. Sci. India, Proc.* 6. *pp.* 49–56, *Feb.*, 1936.—The author points that Sulaiman, in calculating the deflection of light and the perihelion of Mercury on his new theory, has made his approximations incorrectly. If the necessary corrections are applied the deflection of light by the sun is 2″·03 and the advance of the perihelion is 35″·75 neither of which is in agreement with observation. **S. M. Sulaiman** adds some comments on the paper, asserting that the value, 2″·03, for the deflection is in agreement with observation and that the observed amount of the advance of the perihelion of Mercury is not reliable. G. C. McV.

2565. Transformation of Reference Systems in the Page Relativity. H. T. Engstrom and M. Zorn. *Phys. Rev.*, 49. *pp.* 701–702, *May* 1, 1936.—Arising out of the work of Page [see Abstract 2025 (1936)] it is required to find all coordinate transformations which preserve the property that light should travel with constant speed in straight lines in all systems and that space-coordinates should be Cartesian coordinates in Euclidean space. It is noted that the solution of this problem has been given by Lie, the transformations being four-dimensional rotations and transformations by reciprocal radii. The latter are studied in some detail. G. C. McV.

2566. General Foundations of Physics. Part I. R. Tomaschek. *Die Physik*, 4. 2. *pp.* 47–62, 1936.—The experimental evidence for the constancy of the velocity of light, the motion of the earth relative to the æther and the Fitzgerald contraction, the bending of light rays in the sun's gravitational field, the motion of the perihelion of Mercury and the recession of the nebulæ, is reviewed. Since the author rejects "recent speculative hypotheses," no mention of relativity theory is made, and all the above-mentioned phenomena are presented as disconnected experimental facts. G. C. McV.

See also Abstracts 2532, 2533, 2556, 2557, 2558, 2559, 2560, 2862, 2877.

SOLUTION.

2567. General Expression for the Velocity of Solution of a Solid. R. L. Müller. *Acta Physicochimica*, 4. 3. *pp.* 481–493, 1936. *In German.*—The solution of a solid at a square surface of unit area, past which a liquid is moving in laminar flow, is considered mathematically. A general formula, involving constants both of the process of solution and of the removal of the dissolved substance from the surface, is derived for the velocity of solution. The treatment is regarded as tentative, but there is no serious lack of harmony with the available experimental data. L. A. W.

2568. Solubility of Lead Sulphate in Aqueous Solutions of Sulphuric Acid at High Concentrations. H. D. Crockford and J. A. Addlestone. *J. Phys. Chem.* 40. *pp.* 303–305, *March*, 1936.—The solubility of lead sulphate in various solutions of sulphuric acid at concentrations above 80 % and at 0°, 25°, 35°, and 50° C. is determined. The solid phase of 25°, 35°, and 50° C. is always lead sulphate. At 0° C. sulphuric acid and sulphuric monohydrate also exist as solids. AUTHORS.

2569. Solubility of Lanthanum in Mercury from 0° C. to 50° C. W. G. Parks and J. L. Campanella. *J. Phys. Chem.* 40. *pp.* 333–341, *March*, 1936.—La amalgams are prepared by direct heating of the metal with Hg and by the electrolysis of $LaBr_3 \cdot H_2O$ in absolute ethyl alcohol. The solubility of La in Hg is reported at 0°, 12·5°, 25°, 37·5° and 50° C.

In the temperature range from 0° to 50° C. the solubility is represented by the equation: $\log N_2 = -1020/T - 0 \cdot 4575$. A brief discussion of the problems affecting the determination of the solubility of a sparingly soluble metal in Hg is given. The low solubility of La in Hg indicates that La has a rather high internal pressure, approximately the same as that of Bi. From the general behaviour of La amalgam the authors consider it unsuited for precise e.m.f. work without considerable difficulty. AUTHORS.

2570. Solubility of Hydrogen in Organic Solvents. E. B. Maxted and C. H. Moon. *Faraday Soc., Trans.* 32. *pp.* 769–775, *May*, 1936.—The solubility of H_2 in acetic acid, ethyl alcohol, ethyl acetate, chloroform and benzene is determined over various ranges of temperature lying between 0° and 75°. In each case a positive temperature coefficient is observed. The results are examined critically in connection with the known solubility values at 20° and 25° and, in the case of benzene—for which solubility measurements have already been made up to about 60°—over a wider range. In general, where checking values are available, there is good agreement. AUTHORS.

See also Abstract 2524.

SURFACE TENSION AND COHESION.

2571. Electrocapillary Phenomena in Fused Salts. S. Karpatschoff and A. Stromberg. *Zeits. f. phys. Chem.* 176. *Abt.A.* 3. *pp.* 182–186, 1936.—The electrocapillary curves are drawn for the metals Sn, Pb, Cd and Tl in mixtures of two fused electrolytes, *viz.*: KCl and LiCl, and KI and LiI. Gouy's method was employed with fused Pb as auxiliary electrode, and full experimental details with diagrams are included. For the above metals in the same electrolytes, very different potential differences were obtained between the capillary and auxiliary electrodes. As in aqueous solutions so also in fused electolytes the differences between the p.d.s. at the maxima of the electrocapillary curves of the given metals in the same electrolytes are not zero. The capacity of the electrolytic double layer has been determined graphically for Sn from the electrocapillary curve. The capacities belonging to the equilibrium potential of Sn in both electrolytes amount to 90–100 μ F/cm². H. H. Ho.

2572. Creeping of Saturated Salt Solutions. T. H. Hazlehurst, Jr., H. C. Martin and L. Brewer. *J. Phys. Chem.* 40. *pp.* 439–452, *April*, 1936.—The previous work of Washburn and of Druce is extended, and a few roughly quantitative results obtained. The hypothesis advanced by them as to the mechanism of creeping is extended to explain the formation of the capillaries they assume. Creeping is supposed to occur when the solute is capable of displacing the solution from, and spreading over, the supporting surface. Creeping is commonly accompanied by "flooding," a process which loosens the compact mass and permits capillaries to form. The solution rises through the capillaries and over the outermost edge of deposited material, which is shown to be in optical contact with the surface. The effect of the nature of the supporting surface, of the crystal habit of the solute, and of the various free surface energies involved are discussed. Certain curious crystal formations are noted. AUTHORS.

2573. Wetting of Quartz, Calcite and Gypsum by Molten Sulphur. K. N. Samochwalov and N. A. Held. *Kolloid Zeits.* 75. *pp.* 89–94, *April*, 1936.—The wetting at 120° C. and 140° C. of quartz, gypsum, calcite, and 2 $CaSO_4 \cdot H_2O$ by molten S is studied in water, air, and in an atmosphere of water vapour, by photographic measurements of contact angles. It is found that soda, water-glass and extract of oakbark considerably reduce the wettability of 2 $CaSO_4 \cdot H_2O$ and calcite by molten S, and of quartz by bituminous S, and that these substances therefore promote fusion in autoclave experiments. P. H. B.

See also Abstracts **2466**, **2500**, **2502**.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***2574. Quartz Clocks at the Physikalische-Technische Reichsanstalt. A. Scheibe and U. Adelsberger.** *Phys. Zeits.* 37. *pp.* 185–203, *March* 15, 1936. *From the Reichsanstalt.*—The rates of the three quartz clocks I, II, and III, as obtained from the mean astronomical time provided by three observatories, are given for the period Jan., 1933, to June, 1935. There are differences of 0·002 sec. between the measured rates of clocks I, II, and III and the rates calculated from a linear formula, though the differences between the clocks themselves amount to only a few ten thousandths of 1 sec. These variations must be attributed to variations of the astronomical day. In June, 1934, all three clocks showed an increase of rate of 0·004 sec., and the probability is that this was due to the same cause. As a frequency standard during the period June 1, 1933, to May 30, 1935, quartz clock III has increased in value by a total amount of $3 \cdot 4 \times 10^{-7}$ of its value. Since Jan. 1, 1934, the daily increase in frequency was 2×10^{-10} of its value. The frequency was predeterminable for long periods with an accuracy of $\pm 1 \times 10^{-8}$ of its value. [See Abstract 4793 (1933).] L. E.

VISCOSITY, FRICTION AND LUBRICATION.

2575. Viscosity of Aqueous Solutions as a Function of Concentration. Part III. G. Jones and H. J. Fornwalt. *Am. Chem. Soc., J.* 58. *pp.* 619–625, *April*, 1936.—The absolute density and relative viscosity of many solutions of CsI and $KMnO_4$ in water are measured at 0 to 25°, covering a range of concentration from extreme dilution nearly to saturation. The density of these solutions can be expressed as a function of the concentration by Root's equation. CsI is nore effective in lowering the viscosity of water than any other known salt. Cox and Wolfenden's suggestion that this effect is approximately an additive property of the ions is confirmed. It is shown for the first time that permanganates have the property of diminishing the viscosity of water. The extended Jones and Dole equation is found to fit the authors' data better and over a greater range of concentration than any other known equation. The results confirm the equation of Falkenhagen and Vernon for the computation of the influence of interionic attraction on the viscosity. [For Part II see Abstract 5193 (1933).] AUTHORS.

2576. Adhesion of Metal Surfaces in a Vacuum. R. Holm and B. Kirschstein. *Wiss. Veröff. a. d. Siemens-Werken*, 15. 1. *pp.* 122–127, 1936.—Describes an experimental investigation into the adhesion between two metal surfaces, in this case a wire inside a cylinder, in a vacuum and in certain gases at low pressures. The materials investigated were Ni, Pt and graphite and the gases were wet and dry air, A, N_2, H_2 and water vapour. It is seen that air and water vapour tend to reduce the friction between the surfaces. E. O. T.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2577. Reflection Compensators for Testing Paraboloids. C. R. Burch.** *Roy. Astron. Soc., M.N.* 96. *pp.* 438–461, *March,* 1936.—Methods are described for testing paraboloids null-fashion at the centre of curvature, as if spherical, compensating the spherical aberration with a reflecting compensator which is four times smaller than the paraboloid. For apertures up to F/5 the two compensating surfaces may be spherical. The use of this method in refiguring a 36-in. mirror is discussed. AUTHOR.

***2578. Spectrographic Equipment of the 200-in. Telescope.** *Nature,* 137. *pp.* 643–645, *April* 18, 1936.—The *f*/0·36 spectrographic object-glass needed to be an "immersion" lens in order to better the capacity of the *f*/0·59 Rayton, and to have a numerical aperture of, at least, 1·4 in order to increase 3-fold the Rayton's rapidity, and thus to double (nearly) the range within which the apparent velocities of the nebulæ can be investigated. For this lens it is necessary to follow the general lines adopted in designing microscopic object-glasses of large aperture, and compensate the curvature of field left unbalanced by the "secondary spectrum correction" by corrections which would flatten the focal surface passing through the tangential astigmatic images; it also introduces under-corrections for spherical aberration in oblique image-forming rays. Such a lens, giving a flat field for dispersed parallel beams covering the range 3600–5000 Å, when tested at Mt. Palomar (where the night sky is free from scattered light) promises results of great value. [See Abstract 1524 (1936).] A. S. D. M.

***2579. Accuracy of Stellar Positions from Photographic Plates treated by the Normalising Process. P. van de Kamp and A. N. Vyssotsky.** *Astrophys. J.* 83. *pp.* 391–393, *May,* 1936.—The normalising process [see Abstract 4904 (1934)] was tested on four additional emulsions. The positions of 31 stars in the open cluster I.C. 4665 were measured. It is concluded that the general use of the normalising process is not warranted for 5 × 7 in. Cramer Iso Presto plates, except where improvement of positional accuracy near the edge is desired. AUTHORS.

***2580. Measuring Apparatus for Photographic Plates up to 240 mm. × 240 mm. H. Ritter.** *Zeits. f. Instrumentenk.* 56. *pp.* 196–210, *May,* 1936.—A description of the construction and testing of a plate measuring machine taking astronomical plates up to 24 cm. × 24 cm. C. B. A.

***2581. Sextant with Improved Filters. E. O. Hulburt.** *J.O.S.A.* 26. *pp.* 216–218, *May,* 1936.—Polarising plates, made of polarising film cemented between glass, provide a new and convenient filter for the navigator's sextant. The celestial filter consists of two polarising plates, one or both of which may be interposed into the optical path, and when both are in position, one may be rotated with respect to the other to yield the desired reduction in light intensity of the celestial object. The combination is a rapidly adjustable variable filter. The horizon filter likewise consists of two polarising plates. These fulfil a double function. One plate is set with axis of polarisation vertical; this usually sharpens the sea sky horizon and diminishes the glare of the sun path. The addition of the second plate, which is rotatable, provides a rapidly adjustable variable filter. AUTHOR.

COMETS AND METEORS.

2582. Orbit of the Prambachkirchen Meteorite. J. Rosenhagen. *Akad. Wiss. Wien, Ber.* 144. 2*a*. 7–8. *pp.* 419–436, 1935.—The orbit of the meteorite which fell at Prambachkirchen in Upper Austria on Nov. 5, 1932, is deduced from the observational data of over 30 observers. This meteorite was remarkable on account of an unusual change of direction which it suffered towards the end of its course, and which is explicable from the disc-like shape of the stone. The various elements of the atmospheric and cosmic orbits are computed, the latter being collected together in tabular form. J. E. K.

2583. Meteor Heights. B. S. Whitney. *Roy. Astron. Soc., M.N.* 96. *pp.* 544–547, *March,* 1936.—Formulæ are developed for computing the heights of meteors. The observed directions from two stations are thereby adjusted through equal angles, and minimum values furnished for the errors of observation. A least-squares solution is developed for determining heights of meteors or fireballs from observations made at two or more stations. AUTHOR.

COSMOGONY.

2584. Kinetic Energy of the Stars. P. Salet. *Comptes Rendus,* 202. *pp.* 1261–1262, *April* 6, 1936.—The author has suggested the maintenance of stellar mass by meteors and cosmic dust. This would counteract the effect of varying mass, due to radiation, on the kinetic energy; but the effects could only accidentally cancel out and the difficulty raised by M. Mineur remains; also there is insufficient cosmic dust in interstellar space to maintain the sun's mass in the future. [See Abstract 1085 (1936).] T. L. M.

2585. Kinematics and World-Structure. Part III. H. P. Robertson. *Astrophys. J.* 83. *pp.* 257–271, *May,* 1936.—The structure of a statistical system of particles satisfying the cosmological postulate is examined from the standpoint of the kinematics developed [see Abstract 2068 (1936)]. It is found to depend on a single arbitrary function χ of two variables in addition to the constant k and the function ξ of one variable, which specify the kinematical background of the idealised space-time. The distribution function χ is interpreted as a significant constant of the motion; and the complete determination of the entire system is discussed on imposing (*a*), the general relativistic theory of gravitation; (*b*), the extension of the Newtonian theory discussed in Part II; and (*c*), the kinematical-statistical theory proposed by E. A. Milne. The conclusions, if not actually favourable to the relativistic theory, at least nullify certain formal objections which have been raised against it. AUTHOR.

See also Abstract 2590.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2586. Perturbations of Eccentricity in the Problem of Two Bodies of Slowly Increasing Mass. L. Gialanella. *Accad. Lincei, Atti,* 22. *pp.* 529–533, *Dec.* 1, 1935.—In the problem of two bodies of slowly increasing mass, the total variation in the eccentricity of the relative orbit for a complete revolution is calculated to the first order. The particular cases are considered where the mass varies in accordance with (i) a cubic polynomial in the time, (ii) an exponential function in the time, and the conclusion is reached that in general the eccentricity continually diminishes with successive revolutions. A. J. McC.

2587. Anepicyclic Regions in the Asteroidal 3-Body Problem. N. Moissejev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 3. *pp.* 107–108, 1936. *In German.*—It is shown that in the problem of the motion of an asteroid under the attraction of the sun and Jupiter, four regions exist in which a trajectory, with no singularity in the sense of Hadamard, cannot lie completely. [See Abstract 2006 (1936).] G. C. McV.

2588. Liapunoff's Stability Theory. N. Moissejev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 4. *pp.* 165–166, *and* 1. 5. *pp.* 215–218, 1936. *In German.*—Liapunoff's theory of stability in the 3-body problem is shown to be a special case of a more general theory. An illustrative example is given. G. C. McV.

NEBULÆ.

2589. Galactic Nebulæ. J. H. Reynolds. *Roy. Astron. Soc., M.N.* 96. *pp.* 393–399, *Feb.* 1936. *Nature,* 137. *pp.* 601–604, *April* 11, 1936.—The author discusses the relationship with involved or neighbouring stars of luminous nebulosities. Bright clouds are lit up either by reflected light from B_2 (or cooler) stars, or the atoms are excited by the intense u.v. radiation of B_0 (or hotter) types, and show radiations of H, O (in three states) and He, but contain no solid particles, though beyond this range, the atoms may combine to form molecules of frozen dust. He describes three extraordinary examples of reflection in variable nebulæ; Hind's near T Tauri, N.G.C. 6729 near R. Cor Aust, and Hubble's in Monoceros. He attributes planetaries to the shells blown off by Novæ of which O type (probably dwarfs) now form the central stars, the shells being illuminated by strong radiation in the extreme u.v. at a maximum beyond the atmospheric limit. He discusses the theories covering Laquanta of Zanstra and Ambarzumian. A. S. D. M.

PLANETS.

2590. Quantum Statistics and Internal Constitution of Planets. D. S. Kothari and R. C. Majumdar. *Nat. Acad. Sci., India, Proc.* 6. *pp.* 57–65, *Feb.,* 1936.—This paper gives an account of work which has led to a relation between the radii and masses of the planets. This is arrived at by combining with the usual theory of the white dwarf stars, the theory of ionisation in degenerate matter (pressure ionisation). The agreement between theory and observation is reasonably good. AUTHOR.

2591. Equatorial Current of Jupiter. A. S. Williams. *Roy. Astron. Soc., M.N.* 96. *pp.* 548–552, *March,* 1936.—Rotation periods for the S. equatorial current are found for 1880–1, 83–4, 84–5, 91, 93–4, and 95–6. The entire material is tabulated. There is no evidence of the solar cycle; doubtful 9 and 3 year periodicities appear. The velocity of the current decreases continuously from 1880 to 1927 apart from minor fluctuations. Periods are also found for the runaway spots of 1880 to 1884. [See Abstract 1090 (1936).] T. L. M.

2592. Mars, 1935: Seasonal Phenomena. G. Fournier. *Comptes Rendus,* 202. *pp.* 1262–1264, *April* 6, 1936.—Reports results of observations from 26th March to 12th June, at M. Jarry-Desloges' Observatory. Polar cap phenomena were perhaps two months in advance of 1920 and one month in advance of 1918 (comparable oppositions). Bright areas were observed in similar positions adjoining the cap; extensive atmospheric obscuration was also recorded. The dark material formed round the cap was irregularly distributed ; L. Hyperboreus was the principal "reservoir" and the seasonal development of streaks leading to lower latitudes was confirmed. The N. part of Syrtis Major was exceptionally intense and well defined. T. L. M.

STARS.

2593. Period and Eccentricity in Orbits of Binary Stars. H. Horrocks. *Roy. Astron. Soc., M.N.* 96. *pp.* 534–544, *March*, 1936.—The effect of the propagation of gravity with finite velocity is examined. The eccentricity and the period are found to be increased, and the resulting relation between them agrees satisfactorily with the observed statistical relation. The effect of varying mass is also included in the equations. The motion of a binary system in space is also examined, and appears to be not inconsistent with available observational evidence. The time scale for the development of the orbits of stars under these circumstances is also examined. It is proportional to the velocity of propagation of gravity, and need not exceed the time scale derived from the theory of stellar evolution by the loss of mass by radiation in order that a sufficiently large value may be assigned to that velocity to satisfy other necessary conditions. The eccentricity is found to increase rapidly when small. AUTHOR.

2594. Proper Motions of 651 Stars in 97 Selected Areas. P. T. Oosterhoff. *Mt. Wilson Observat. Contrib. No.* 542. *Astrophys. J.* 83. *pp.* 340–371, *May*, 1936.

2595. Red Colour Indices. Cecilia P. Gaposchkin and S. Gaposchkin. *Harvard Coll. Obs., Ann.* 89. 7. *pp.* 119–122, 1935.—To investigate the relation of the red to the photographic and photovisual systems, the red magnitudes of all B.D. stars within 2° of the 1855 Pole were measured on three I-C special plates with a Ciné red filter by direct reference to the North Polar sequence, and divided into two groups: Group I, containing stars for which both *pg* and *pv* magnitudes are given by Seares, Ross and Joyner ; and Group II, for which they give only *pv* magnitudes, and colours derived from Potsdam Polar Durchmusterung and Greenwich effective wave-lengths. Least-square solutions and correlation methods of the relation red-blue to yellow-blue colour index, both show that I and II differ significantly. This might be due : (*a*) to scale error, (*b*) to a difference in blue-yellow colour system between the two groups, or (*c*) to the relation between blue-red and blue-yellow colour indices being non-linear. This last seems the most probable. [See Abstract 4506 (1935).] A. S. D. M.

2596. Reddening in B-Type Stars. Jessie Rudnick. *Astrophys. J.* 83. *pp.* 394–400, *May*, 1936.—Spectrophotometric differential energy-curves of normal and reddened B-type stars are found to approach those predicted for Rayleigh scattering over the region of long wave-lengths. The observed energy-curves deviate more and more on passing toward the violet, corresponding to a change in the exponent in Rayleigh's law. The observations are interpreted in the light of Götz's theoretical work. Approximate limits to the sizes of the scattering particles are found to be 300 $m\mu$ and 60 $m\mu$. AUTHOR.

2597. Absorption Line Displacements in Spectrum of P Cygni. E. K. Kharadse. *Zeits. f. Astrophysik*, 11. 4. *pp.* 304–319, 1936. *In English.*—The object of the paper is to examine the supposed correlation between the displacements (and radial velocities) of the absorption components in the spectrum and (*i*) their intensities, (*ii*) their ionisation potentials, (*iii*) their wave-lengths; 120 absorption and 42 emission lines were measured between 3750 and 6680 Å, including 10 Balmer lines. The photographic effect of the emission component on the displacement of the absorption line is examined and a correction curve obtained. Correlation (*ii*) is confirmed, but there is no evidence of (*i*); (*iii*) appears to be due to the photographic effect increasing with decrease of linear dispersion. T. L. M.

2598. Absorption-Line Intensities in B-Type Stars. E. G. Williams. *Mt. Wilson Observat. Contrib. No.* 540. *Astrophys. J.* 83. *pp.* 279–304, *May*, 1936.—Measures are made of absorption-line intensities over λλ 4922–3820 on 84 calibrated plates for O- and B-types, previously used for a study of interstellar calcium lines. These last probably present a series of lines of different intensities, all saturated. The absorption lines are divided into (1) hydrogen, (2) helium, in both of which depth in line contour diminishes exponentially with distance from centre, and (3) other lines in B-stars which are relatively weak, the observed contours bearing little relation to the true. Tables and a figure are given of these together with results from other lists, which indicate that systematic errors are small. For the Balmer-line intensity variations, the spectral behaviour of line depths is like that of the total intensities; there is a tendency for the deepest line to be further down the series for dwarfs than giants and for cooler subtypes than hotter. No interpretation of results can be given until the high central intensities are explained, but the results agree with Pannekoek and Verwey's Stark effect [see Abstract 2893 (1935) and following Abstract]. A. S. D. M.

2599. Classification of B-Type Stars. E. G. Williams. *Mt. Wilson Observat. Contrib. No.* 541. *Astrophys. J.* 83. *pp.* 305–339, *May*, 1936.—The author finds clear indications of absolute magnitude effect on examining lines of different atoms with revised type [see preceding Abstract]. He discusses critically the Henry Draper System and separates line-ratio from absolute intensity methods; he depends wholly on intensity ratios. A list and diagrams are given for the ratios and their values for subtypes, the most useful being the ratio of mean depths of ^{3}D lines of helium to hydrogen $H\gamma$–$H\zeta$. Lines of 5 different He series give similar absolute-magnitude effects similar in sign to that found for the H lines, and extend to the earliest types. Stark effects also influence intensities. Diagrams indicate a smooth progression of maximum spectral types with the ionisation of the corresponding atom, showing that the classification is a true temperature one. From the velocities of 56 stars with measured interstellar K-lines, the relation, K intensity $= 0\cdot37$ equivalent angströms per kiloparsec, is found, and $M = m - 12\cdot2 - 5 \log K$ may be used to compute absolute magnitudes. A. S. D. M.

2600. Selective Interstellar Absorption. F. Becker. *Zeits. f. Astrophysik*, 11. 5. *pp.* 356–358, 1936.—The colour indices in the Bonn Spectral Photometry of the Kapteyn Fields in the southern hemisphere have been used for investigating the question of selective interstellar absorption. The result is negative, but it appears that there is a distinct correlation between colour excess and absolute magnitude in Ko stars. M. A. E.

2601. Schuster's Problem for a Moving Atmosphere. W. H. McCrea and K. K. Mitra. *Zeits. f. Astrophysik*, 11. 5. *pp.* 359–378, 1936.—The problem of the scattering of radiation in a medium in non-uniform motion is discussed. In particular Schuster's problem for such a medium, with special reference to the formation of an " absorption line," is examined. The physical features of the case are described and a quantitative estimate of the line profile, depending on elementary arguments, is given. The general equation of radiation transfer is written down and appropriate solutions for small velocities and weak scattering are given. The analogue of the Schuster-Schwarzschild approximation for the general case is discussed and leads to rather intractable partial differential equations. A rough estimate of the total line strength can, however, be got from them. The general conclusion is that the simple formula is correct in general as regards order of magnitude. A numerical illustration of the formula is given. AUTHORS.

2602. Variation in Fraunhofer Line Intensity over the Disc of the Primary Star of U Cephei and of U Sagittæ. R. O. Redman. *Roy. Astron. Soc., M.N.* 96. *pp.* 488–506 ; *Disc.*, 506–508, *March*, 1936.—An attempt has been made by means of spectrographic observations during eclipse to detect changes of Fraunhofer line intensity from centre to limb of the primary component in each of the Algol systems, U Cephei and U Sagittæ. Corrections to the observed line intensities are required on account of the superposition of the secondary spectrum, and these corrections become rather large during the important phases near totality. However, the uncertainties thus introduced do not seem sufficiently great to affect the essential nature of the result that in the principal star of U Cephei, spectral type A0, the H Balmer lines behave as though they vanish at the limb, while in U Sagittæ, type B9, there is a definite fall in intensity from centre to limb. In the case of fainter lines, such as H (blended with $H\epsilon$) and K of ionised Ca, the measures were not sufficiently accurate to lead to any definite conclusion. AUTHOR.

2603. Radiation Temperatures of Main Sequence Stars. K. Pilowski. *Zeits. f. Astrophysik*, 11. 4. *pp.* 265–303, 1936.—The aim is to set up a scale of radiation temperatures for stars of the main sequence of the Russell diagram by deriving a relation between spectrum type and surface brightness. Material is collected for 26 eclipsing and 27 visual double stars which have been fully investigated. The relation between spectrum and luminosity is given from the Russell diagram and is fully discussed. The material collected gives a relation between radius and spectrum, and from the radius and luminosity, the surface brightness and therefore radiation temperature are found. The method adopted avoids the need for a parallax of eclipsing stars. Seven binary systems are used to give an estimate of the temperature of red giant stars ; and various statistical considerations are introduced to improve the temperature scale derived for the main sequence. T. L. M.

2604. Internal Constitution of Perfect Gas Stars. A. v. Brunn. *Zeits. f. Astrophysik*, 11. 5. *pp.* 379–391, 1936.—A numerical evaluation of two models suggested by the work of ten Bruggencate [see Abstract 2447 (1935)] is made. G. C. McV.

2605. Eclipse of ζ Aurigae, 1934. P. Guthnick, H. Schneller, and O. Hachenberg. *Preuss. Akad. Wiss. Berlin, Abhandlungen, No.* 1, [53 *pp.*], 1935.—Report on observations at Babelsberg, Wolfersdorf, etc., of the eclipse of the B8-9 component by the K5 supergiant component from

Aug. 23 to Oct. 1. Methods and corrections are fully described. The elements of the binary system are derived. Among the results are: Inclination 80°·47. Ratio of radii, 1: 73; of masses 1 : 2·47. Masses, 13, 32 (Sun = 1). Temperature by three methods: K star, 3160° abs., B star, 15000°. The K line was visible only one week, compared with a month in 1934; radial velocities from this line give the radius of the K star 283×10^6 km., against 204×10^6 from the light curve. Other chromospheric lines give small rotational effects and are apparently involved with photospheric lines. The envelope of the giant star evidently varies in dimensions and rotation. The observation of the eclipse, 1940 Jan. 8, is recommended. T. L. M.

2606. Variable Spectrum of π (52) Aquarii. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 96. *pp.* 480–488, *March,* 1936.—A discussion is given of 81 photographs of the spectrum of π Aquarii taken between 1928 Sept. 4 and 1935 Nov. 18. The variations between the relative intensities of the bright components of the hydrogen lines, during this interval, suggest a mean period of about 1087 days, but the period is not constant. There is evidence to indicate that this mean period was probably not in operation immediately prior to the year 1928. There are times when these bright H components disappear entirely. Brief references are made to the work of other observers. AUTHOR.

2607. Fission-Theory of Eclipsing Variables. E. A. Kreiken. *Zeits. f. Astrophysik.* 11. 5. *pp.* 323–336, 1936.—It is known [see Abstract 3363 (1935)] that the period of axial rotation of a single star is determined by its mean density so that $\log P = -{}^1/_2 \log \rho + C$. The period of axial rotation and of orbital revolution of an eclipsing variable depends on the value $\log \rho$ obtained from the component of smallest density.—This explains why spectroscopic binaries and eclipsing variables as a class have smaller velocities of axial rotation, than the single stars. With the recent binary systems the peroid of orbital revolution is also given by the formula $\log P = -{}^1/_2 \log \rho + c$. With the older systems this period increases and is given by $\log P = -{}^1/_2 \log \rho - 0\cdot645 - 1{}^1/_2 \log \{(R_1 + R_2)/R\} - 0\cdot190 \mid \Delta \log \rho \mid \pm 0\cdot070\ (p\cdot e)$. AUTHOR.

2608. Shapes of Light Curves of Long-Period Cepheids. P. P. Parenago and B. W. Kukarkin. *Zeits. f. Astrophysik,* 11. 5. *pp.* 337–355, 1936.—A critical survey is made of previous papers on the shapes of light curves of long-period Cepheids. No reliable positive evidence of variation of the shapes of light curves is found to exist. The presence of large systematic errors is the chief objection against the curves used in most of the earlier studies; an attempt is made to eliminate these errors by forming normal curves, *i.e.* by compounding into a single curve all mean curves of a star derived from independent series of observations. 162 normal curves are determined, of which 102 are selected for statistical discussion. Interrelation of the period, asymmetry, phase and area of the hump, and other characteristics of the shape of light curves is studied. The shape of the curves is found to depend very closely on the period length. The run of all characteristics relative to the period suffers a break at P = 9 days. A suggestion is made that there are two kinds of light variation in long-period Cepheids, the one playing the dominant rôle in stars with periods less than 9 days, and the other, in stars with periods above 9 days. AUTHORS.

2609. Spectra of Long-Period Variable Stars. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 539. *Astrophys. J.* 83. *pp.* 272–278, *May,* 1936.—Low-dispersion spectrograms of a number of long-period variables of classes Me and Se, taken during the fainter phases, are briefly described. The chief general results are: (1) the continuous spectrum of Me variables is remarkably strong between λ 4226 and H; (2) the intensities of the dark H and K lines differ widely in different variables; (3) large changes in total light may occur without marked changes in the absorption spectrum; (4) the bright hydrogen lines, as well as λλ 4202, 4308, 4571, behave in the manner previously outlined; (5) certain long-period variables do not have observable " companion " spectra at minimum light; (6) interesting peculiarities were found in the spectrum of χ Cygni near minimum. AUTHOR.

2610. Infra-Red Photometry of Long-Period Variable Stars. C. Hetzler. *Astrophys. J.* 83. *pp.* 372–390, *May,* 1936.—Variable star work at 8500 Å (for twilight, moonlight, or poor seeing) has been done with the Thaw 30-in. refractor (at Allegheny) and the 24-in. reflector (at Yerkes). A combination of filter, emulsion and focus give a compact region where brighter and bluer stars are comparable in energy with very red stars; the brighter red stars have great intensity even at minimum light. Comparison stars are compared with Vega (of zero infra-red mag.) and a table is given of their infra-red magnitudes. Results for about 30 variables are shown in 6 curves and tabulated. Dwarf M-stars, in general, are not comparable in infra-red intensity with giant variables of the same minimum magnitude. The author discusses the cause of the visual magnitude range, whether due to differential band absorption, or veiling by condensed particles, or change of diameter, if the star is a black-body. He refers to the magnitudes at 8500 Å of Nova Herculis and R. Scuti, and to other stars at 9500 Å. A. S. D. M.

2611. Light Curve of Nova Herculis. H. Krumpholz. *Akad. Wiss. Wien. Ber.* 144. *2a.* 7–8. *pp.* 507–515, 1935.—Upwards of 3000 measurements and estimates of the brightness of Nova Herculis made by over 60 different observers in various localities between the discovery of the star on Dec. 13th, 1934, and April 2nd, 1935, are collected together, critically examined for systematic errors and reduced and corrected as far as possible to a common standard. The reduced corrected brightness values are combined to form new mean values which are collected together in tabular form to serve as a standard for future reference. J. E. K.

2612. Visual Spectrum of Nova Herculis. N. T. Bobrovnikoff. *Am. Phil. Soc., Proc.* 75. 8. *pp.* 717–753, 1935.—A detailed study of emission and absorption bands in the Nova's visual spectrum. In neutral O three emission lines due to the forbidden transitions (λλλ 5577·34 (aurora), 6300·23, 6363·88 (both observed in nebulae)) were present after Dec. 25, 1934; in all three the width increased and the growth of the bands in width seemed as a line with a superimposed sinusoid; in three months one cycle was covered. The OI envelope did not move much with respect to the star but expanded in all directions with variable acceleration and symmetry of expansion; it suggests abundance of oxygen in the Nova's atmosphere. Neither the D-line nor Hα and Hβ lines followed the same course. One Hα emission in March, 1935, gave a maximum relative velocity of about 3400 km./sec. The author suggests that the Nova had two components at maximum brightness; the shape of OI at first, and later of Fe II and Hα indicate another body or else two symmetrical jets; the fission may have occurred in January. The O shell seems to be at rest with respect to the star, and yet it is O that indicated earliest the Nova's duplicity ; all the other elements show large positive velocities of recession. A. S. D. M.

2613. Spectrophotometric Measures of Nova Herculis. W. M. H. Greaves and E. Martin. *Roy. Astron. Soc., M.N.* 96. *pp.* 425–433, *March*, 1936.—On 17 nights between 1934 Dec. 16 and 1935 April 6, the nova was photographed on Hydrogen-Alpha plates when at equal altitude with comparison star ; measures were made, in the regions of Balmer lines Hα, Hβ, Hγ and Hδ and the "forbidden" $\lambda\lambda\lambda$ 5577, 6300, 6364, both of the continuous spectrum and of line intensities near. The plots of continuous spectrum against energy distribution are not Planckian curves though (accidentally) there are small differences between them [see following Abstract]. A table is given of relative line-intensities (Hα = 1) and shows a decrease, as the nova develops, of Hβ and a strengthening of $\lambda\lambda$6300 and 6364. The absolute line intensities do not seem to bear any relation to the visual magnitude ; the output of Hα energy seems most in February more than a month after visual maximum. A. S. D. M.

2614. Colour-Temperature of Nova Herculis. E. G. Williams and H. E. Green. *Roy. Astron. Soc., M.N.* 96. *pp.* 434–438, *March*, 1936.—A discussion of a spectrum plate of Nova Herculis and a comparison star (Iota Herculis), of date 1935 March 15, taken at the Cambridge Observatory. A diagram shows the relation between $\log_{10} I$ Nova $/\mathrm{I}_{10000}{}^{\circ}$ and $1/\lambda$, for the above plate and two other observers [see Abstracts 3799 and 4906 (1935)]. Two conclusions are drawn, (*a*) the energy distribution is not Planckian [see preceding Abstract], and (*b*) the intensity in the ultra-violet is extremely high. The marked change of gradient near the Balmer series head may be due to continuous hydrogen absorption or emission, and if so, the trouble is either in the Nova or (unlikely) in the comparison spectra. The small dispersion of all the spectra forbids any definite conclusion. A. S. D. M.

2615. Bright Line Spectrum of Nova Herculis. F. L. Whipple and Cecilia P. Gaposchkin. *Nat. Acad. Sci., Proc.* 22. *pp.* 195–200, *April* 15, 1936.—The two components of Nova Herculis observed visually can be related to conspicuous features of the bright line spectrum, and appear to be two gaseous masses of low density, ejected from the central star, probably very early in the outburst. The strong absorption lines seen in the early post-maximum stages are considered to be formed at higher levels than the corresponding broad bright lines, in a deep atmosphere built up by the continuous ejection of material from the surface of the original star. It is the latter process that produces the continuous background, while the doubled bright lines arise in the two ejected nebulous masses. AUTHORS.

See also Abstracts 2579, 2584, 2589, 2621.

SUN.

2616. Solar Granulation. H. H. Plaskett. *Roy. Astron. Soc., M.N.* 96. *pp.* 402–425, *March*, 1936.—From spectrophotometric investigations of solar granulation at Victoria and Oxford it has been shown that the maximum value of the surface brightness ratio of granule to intergranular region, after correction to perfect seeing, is 1·10. The surface brightness ratio increases slowly with decreasing wave-length, and, if it does not increase at the limb, at least remains constant over the disc.

The diameter of a granule, measured at the mean surface brightness of the disc, is of the order of 5″, or 3700 km. From the total emission during its lifetime, and from its heat capacity, it is concluded that granules probably arise from convection rather than spontaneous energy generation. From the Rayleigh-Jeffreys theory of vertical instability it is shown that the temperature gradient in the Unsöld zone of instability is sufficient to set up motion, and it is suggested that the granules are the upstreams in the Bénard convection cells to be expected in such motion. The integral equation of radiation transfer is solved numerically and the temperature distribution in the solar atmosphere is found from the observed darkening towards the limb. An isothermal layer is found near the top of the zone of instability, and this is attributed to heat conveyed by the granular convection streams. The relation of granulation to some other solar phenomena is briefly discussed. AUTHOR.

2617. Solar Corona in 1935. B. Lyot. *Comptes Rendus,* 202. *pp.* 1259–1261, *April* 6, 1936.—Using the new coronagraph [see Abstract 1554 (1936)] coronal filaments were observed out of eclipse in August 1935. The spectrum was studied on a number of occasions until October; the following coronal lines were measured repeatedly: 5302·83, 6374·50, 6701·73 (Grotrian's line), 7891·6 (new line); other lines were sought unsuccessfully; the work was extended to 10,300 Å. Equivalent widths of the lines are given. T. L. M.

2618. Absorption Lines and Integral Equation of Radiative Equilibrium. E. Hopf. *Roy. Astron. Soc., M.N.* 96. *pp.* 522–533, *March,* 1936.—Chandrasekar's model of the outer solar layers, an important feature of which is a uniform spectral distribution of the absorption lines in the reversing layer, is discussed rigorously. The mathematical methods developed in the author's Cambridge Tract are applicable to this problem. The equations are transformed into a system of linear integral equations having an unique solution between certain limits. At great optical depth it is found that, as in Milne's standard case, the integrated black-body radiation $B(\tau)$ for the temperature at optical depth τ is $\sim \frac{3}{4} F\tau$, if τ is measured in terms of Rosseland's mean absorption coefficient. In the special case of pure local thermodynamical equilibrium the precise value of $B(0)$, and hence the boundary temperature, is derived. W. J.

***2619. Ultra-Violet Solar Radiation of Short Wave-Lengths. W. W. Coblentz and R. Stair.** *Bureau of Standards, J. of Research,* 16. *pp.* 315–347, *April,* 1936. *Nat. Acad. Sci., Proc.* 22. *pp.* 229–233, *April,* 1936.—Technical details are given for evaluating u.v. solar radiation by two closely agreeing methods: (1) by means of a balanced thermopile and filter radiometer, calibrated against a standard of thermal radiation, and (2) by means of a photoelectric u.v. meter calibrated against a standard of u.v. radiation. A photoelectric cell and filter method for determining the solar u.v. spectral-energy distribution is described. Data are given on u.v. solar radiation intensities observed at Washington, D.C., San Juan, P.R. and Flagstaff, Ariz. The intensity of u.v. solar radiation of wave-lengths shorter than and including 3132 Å, in the clearest, midsummer, midday sunlight at Washington is about 75 μW/cm². decreasing to 0·1 of this value (8 μW/cm².) during the clearest, midwinter, midday sunshine. Extrapolation of the data observed at the three stations (Washington, San Juan, and Flagstaff) indicates an u.v. intensity of about 600 μW/cm². outside the earth's atmosphere—a 5- to 8-fold increase as compared with a 20 to 30 % increase in total intensity of all wave-lengths. AUTHORS.

2620. Determination of Solar Motion. W. M. Smart. *Roy. Astron. Soc., M.N.* 96. *pp.* 461–471, *March*, 1936.—It is shown that the usual grouping of stars into areas of several hundred square degrees for the determination of solar motion introduces systematic errors. Accurate and approximate formulæ are obtained. Numerical estimates of the systematic errors are found when the proper motions and radial velocities are used separately. The application of these corrections makes it possible to deal with larger areas, reducing the number of equations of condition. [See following Abstract.] T. L. M.

2621. Solar Motion and Galactic Rotation from Radial Velocities. W. M. Smart and H. E. Green. *Roy. Astron. Soc., M.N.* 96. *pp.* 471–480, *March*, 1936.—The material previously used [see Abstract 1537 (1936)] is employed to find the solar motion from stars of each spectral type. The method is novel in that the areas are larger than usual and corrections are applied [see preceding Abstract]. The complete material gives the solar velocity 19·5 km./sec. and apex (267°·0, + 32°·0). Solutions for galactic zones show no general dependence on galactic latitude. A solution including the galactic rotation term is made for the B stars; the results for all stars of this type are in good agreement with accepted values; but there is divergence between results for zones of galactic latitude. The high value of the *K* term for B stars is not explainable by the presence of a scattered cluster as proposed by Plaskett and Pearce. T. L. M.

2622. Photometry of Fraunhofer Lines in Region λ5889-6271. C. W. Allen. *Roy. Astron. Soc., M.N.* 96. *pp.* 508–515, *March*, 1936.—In the Canberra investigation of this region with the 3-prism spectrograph the central intensities are open to doubt on account of inadequate dispersion in the red. The first and second orders of the Rowland concave grating of the Cambridge Solar Physics Observatory are therefore used for observations of equivalent breadth and central intensity by photographic photometry, a low-dispersion monochromator being used instead of a filter in front of the slit. The new values of equivalent breadth in this region are only about 3 % greater than the earlier values, while for 15 lines near λ5300 and for 45 lines near λ5600 the new results are greater by 12 % and 15 % respectively than the old, and are in better agreement with Righini's and Mulders' investigations. Central intensities (r_m uncorrected, and r_c fully corrected) and values of line sharpness (d) are tabulated for 60 lines from λ5889·977 to λ6271·289. The excess of the observed over the theoretical values of r_c is now the same at λ6000 as at λ4500, and represents the extra broadening due to line-shifts produced by turbulent motion in the reversing layer. W. J.

2623. Balmer Decrement in Spectra of Prominences. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 96. *pp.* 515–522, *March*, 1936.—Following the methods of Rosseland and Pannekoek, the author has attempted to account for the observed central intensities of the Balmer H lines in the Fraunhofer spectrum by considering four transitions at a time rather than one at a time. The same theory is now applied to the Balmer decrement in spectra of prominences. The present work differs substantially from the previous work of Cillié on the Balmer decrement in emission spectra in that attention is here paid to the composite nature of the Balmer series, the influence of the Lyman radiation and the metastability of the 2*S* state. The relation between Cillié's and the author's investigations is discussed. W. J.

See also Abstracts 2639, 2643, 2654.

GEOPHYSICS.

GEODESY.

2624. Dimensions of the Earth. L. Laboccetta. *Accad. Lincei, Atti,* 22. *pp.* 517–522, *Dec.* 1, 1935.—The radius of the earth, assumed spherical, is obtained as a function of the sidereal day and the periods of oscillation of a metre pendulum at the pole and at the equator. The analysis is based on the author's concept of proper time. For the actual earth pendulum measurements along a meridian would give the variation of radius with latitude. W. S. S.

2625. Gravity Formulæ in Geodesy. B. L. Gulatee. *Indian Acad. Sci., Proc.* 3*A. pp.* 221–235, *March,* 1936.—The more important gravity formulæ are discussed from the point of view of the degrees of approximation involved, as well as of the interpretation of the various terms. W. A. R.

HYDROSPHERE, PHYSICS OF THE.

2626. Periodic Variations of Atlantic Currents. V. V. Šulejkin and N. D. Yeršova. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.,* 1. 5. *pp.* 221–225, 1936. *In English.*—The cause or causes of the periodic variations in temperature in the Atlantic waters are sought for. The authors regard the physical basis of Sandström's theory of Atlantic variations to be at fault and they further assert that the theory does not explain the nature of the thermal variations. Observations of the temperature variations in the Atlantic lead the authors to conclude: (1) The origin of the temperature variations of Atlantic currents is not to be found in the origin of the Gulf Stream; (2) some temperature wave enters the Atlantic from the north; (3) without any predetermination as to the origin of these variations, they are propagated counterclockwise along a closed route which lies partly in the Atlantic and partly in the Arctic encircling the pole. The probable cause of these variations is then investigated and an approximate equation established between the variation in heat content in the Atlantic current and the Polar ice. The solution of the latter shows that the Polar ice transforms the Atlantic Ocean and the Polar Basin adjoining into an auto-oscillating system. In the opinion of the authors a complete answer to the problem will require further investigation. A. E. M. G.

2627. Tidal Oscillations in an Elliptic Basin of Variable Depth. Part II. G. R. Goldsbrough. *Roy. Soc., Proc.* 155*A. pp.* 12–32, *May* 18, 1936.—In Part I [see Abstract 1493 (1931)] the basin was non-rotating, but in this paper the inclusion of the earth's rotation is considered. The equations of the non-rotational case had polynomial solutions of a relatively simple form. The polynomials can be classed into four types, distinguished by irrational coefficients. Certain properties of these functions are discussed. Corresponding to each given type and algebraic order, there is a finite set of polynomials each associated with a distinct characteristic. It is found that the solutions of the rotational problem are composed of all the members of each set of the same order belonging to types I and IV or to types II and III with appropriate coefficients. Since the number of terms is finite it is easy (at any rate for the earlier modes) to work out the complete solutions. The lowest modes for each of the combinations are completed, the basin taken having axes in the ratio $\frac{1}{3}$. The co-tidal lines also are drawn in certain cases. An interesting result is that in the two lowest modes of the ordinary kind, the co-tidal lines are straight lines through the centre of the basin, one set moving in the direction of the rotation and the other moving in the opposite direction. There also appear types of motion of long period of the " second class " which reduce to steady motions when the rotation vanishes. AUTHOR.

LAND, PHYSICS OF THE.

2628. Convection Currents in the Earth. A. L. Hales. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 372–379, *April,* 1936.—The idea of convection currents in the outer shell of the earth is investigated, and it is found that currents sufficient to give the stress differences required by the gravity anomalies are possible. AUTHOR.

2629. Ideal Liquid Inclusions. S. T. Yuster. *Am. J. Sci.* 31. *pp.* 363–372, *May,* 1936.—Geologic thermometry, as indicated by liquid inclusions, is analysed mathematically by the consideration of ideal cases. The inclusions are divided into two groups; namely, those in which the included material was liquid at the time of being formed and those in which a gas was enclosed during formation. Utilising the laws of expansion and contraction and the ideal gas laws, expressions are derived for the temperature of formation. The extent of erosion and the degree of tilting are also calculated for formations containing inclusions of the second kind. AUTHOR.

See also Abstract 2660.

METEOROLOGY.

2630. Daily Variation of Ground Temperature. K. Koenuma. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 213–226, *March,* 1936. *In English.*—In this mathematical paper the author deals with the problem of the exchange of heat between the atmosphere and the surface of the ground. A relation is established between the quantities of heat arriving at and leaving the earth's surface. Approximate solutions of the equations for the variation of the temperature of the ground and of the lower atmosphere are then found. The value of the temperature of the earth's surface is similar to the value got by Brunt. From a more rigorous solution the results show that the temperatures both of the ground and of the atmosphere may be divided into two parts. One part expresses the daily mean values; the second part expresses the daily variations of the ground and the lower atmosphere. The paper concludes with a calculation of the daily variation of the temperature of the surface of the ground. A. E. M. G.

***2631. Wind in Britain: Dines Anemometer and Notable Records. E. Gold.** *Roy. Meteorolog. Soc., J.* 62. *pp.* 167–206, *April,* 1936.—The paper opens with reference to the origin and development of the Dines anemometer. The theory of the shape of the float in the instrument is thereafter treated fully. A standard instrument of the present day pattern is described and the methods adopted to keep the anemometer in perfect order under different weather conditions, and also to permit of its use on board ship, are discussed. The next section deals with the gradual introduction and distribution of the instrument over the British Isles. Records obtained from the instrument at different stations are reproduced, showing the effects of topography and of obstacles on the wind. Winds of special character are also illustrated. A table is given showing the highest gust recorded in each year since 1909 and the highest gust recorded at each place since the inception of the records. Severest gales are shown to come with winds from between S. and W. and highest gusts to occur in the afternoon or evening. In conclusion the author suggests that an effort should be made to obtain sound records as a complement to the records of the Dines anemometer. A. E. M. G.

2632. Diurnal Variation of Wind Velocity. I. I. Schell. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 60–72, 1936. *In English.*—It is shown that with stable conditions the diurnal variation in wind velocity cannot be due to turbulence alone, and, that once overturning of the layers takes place the amplitude is a function of the lapse rate (in the lowest 2 km. layer). Since the diurnal range is determined by the stability of the air stratum the degree of its development may be regarded as varying characteristically with the air mass type and season. AUTHOR.

2633. Theory of Daily Changes in Wind. A. Wagner. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 172–202, 1936.—The Espy-Köppen theory is criticised, amended and extended in the light of recent work, the influence of internal friction and its variation with height on changes in wind velocity and direction with position and heating power of the sun are discussed mathematically. C. A. S.

2634. Change of Wind with Elevation under the Influence of Viscosity in Curved Air Currents. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 203–205, 1936. *In English.*—A solution for the wind distribution was given [see Abstract 142 (1936)] in the form of a Weierstrassian function. Since the wind cannot increase indefinitely with elevation, the function must become exponential. A shorter and more exact method is given here of determining the distribution of velocity. [See following Abstract.] H. M. B.

2635. Vertical Wind Distribution in Anticyclones, Extra-tropical and Tropical Cyclones under the Influence of Eddy Viscosity. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 206–214, 1936. *In English.*—Observational details of cyclones and anticyclones are considered in relation to the theory given earlier [see preceding Abstract]. It follows from theory and is borne out by observation in temperate latitudes that the angle between the pressure gradient and surface wind decreases with increasing distance from the centre in cyclones and increases in anticyclones. In tropical cyclones, where the centrifugal force plays a much larger part than in the temperate latitudes, its influence must be much more pronounced. In hurricanes, the height to which there is a considerable inflow of wind becomes less, which may be some indication of the cause of the "eye of the storm," where there is no condensation and no inflow of air causing a calm. Theory agrees well with observation for the angle between the pressure gradient and the surface wind in relation to the distance from the centre. H. M. B.

2636. Vertical Currents in the Atmosphere. K. R. Ramanathan and K. P. Ramakrishnan. *India Meteorolog. Dept., Sci. Notes,* 6. 67. *pp.* 213–222, 1936.—The paper discusses the results of some measurements of vertical currents in the atmosphere obtained with liftless balloons at Poona. These balloons were first carried up to different heights in the atmosphere varying from about 0·5 to 2·0 km. and released there by means of timed fuses. On clear days in the dry season, vertical currents are generally weak in the mornings and marked in the afternoons; on one occasion, the upward velocity went up to 14 km./hr. The vertical currents observed on some days with cumulus and cumulo-nimbus clouds are also described. AUTHORS.

2637. Eddy Conductivity of Air over Smooth Snow Field. H. U. Sverdrup. *Geofysiske Publ.* 7. [69 *pp.*], 1936. *In English.*—This paper is based on observations made on Isachsen's Plateau on West Spitzbergen in the summer of 1935. The exchange of heat between different layers of air depends on both eddy convectivity and eddy conductivity. These are discussed in separate sections. Each is considered first from the point of view of laboratory results and theoretical considerations and then in the light of observations in the open previous to those of the present investigation. The next two sections of the paper are devoted to a discussion of the observations taken on Isachsen's Plateau of wind, temperature, humidity, vapour pressure and their vertical variations together with that of cloud, fog and precipitation. Some empirical results dealing with the average thickness of the semi-laminar boundary layer are considered. An examination of the exchange of heat and water vapour between the snow surface and the air enables a computation of the eddy conductivity to be carried out from the above observations. A comparison is thereafter made with results obtained from other investigations. The empirical and theoretical values of the eddy conductivity are compared in the concluding section. In a set of tables appended the records of the observations are given. A. E. M. G.

2638. Diurnal Variation in Ceiling Height beneath Stratus Cloud. E. M. Vernon. *Monthly Weather Rev.* 64. *pp.* 14–16, *Jan.*, 1936. —The region considered in the paper is San Francisco Bay. The stratus cloud there is the inland extension of the " high fog " common to the coastal area of California. A cool moist air overlies the bay and above is warm dry air. Just below the inversion level the stratus forms in what is an unstable air mass through which convection cannot penetrate. It is dissolved in the daytime when the saturation level is increasing. This information results in improved ability to forecast the time of formation and dissolution of the stratus. To indicate the height of the ceiling the height of the inversion level at different times of the day must be known. The conclusions drawn by the author are (1) if a stratus cloud is sufficiently thick to be practically opaque to terrestrial radiation there will be a tendency towards rising ceiling and (2) if a stratus cloud overlies a surface whose temperature is low compared to that of the radiating surface of the cloud there is a tendency towards decreasing ceiling. A. E. M. G.

2639. Influence of Sunspot Period on Precipitation. S. Hanzlik. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 15–30, 1936.—To study the influence of the sunspot period on precipitation, the author makes use of the difference between the mean precipitation in the three years near sunspot minima and the same for the following three years of sunspot maxima. For this the term " effect " is used. Ten periods between 1821–1929 are dealt with. When period and effect are plotted, curves are found mainly of two types, termed B and C types. These oscillate in opposite directions from one sunspot period to the next and thus there arise periods with two sunspot periods between two crests. Further, on account of the successive changes of sign of the effect, there exists besides the periods corresponding to the single or double sunspot periods, a period of 16 years together with one of 6 years. This oscillation is found to be regular in certain parts of the globe and is considered as indicating the possibility of long range forecasting. The distribution of both the B and C types over the globe appears irregular. Five charts, one for the year and four for the seasons, illustrate these distributions. A. E. M. G.

2640. Rainfall from above 6000 Feet, in Relation to Upper Wind and Fronts. C. K. M. Douglas. *Roy. Meteorolog. Soc., J.* 62. *pp.* 207–217; *Disc.*, 217, *April*, 1936.—Rainfall from above 6000 ft., and the movement of rain areas with the winds at those levels, are of importance in forecasting, and sometimes cause difficulties. A suggested classification of " thermal " upper winds is into ideal frontal, frontal zonal, and non-frontal types. The upper wind system of an ideal front is briefly discussed. Non-frontal " thermal " winds sometimes cause an exceptional forward extension of a rain area. A rain area is also liable to travel in an abnormal manner along a front, owing to upper winds of frontal zonal type. Quasi-frontal and non-frontal rainfall, in connection with which upper winds are often important, are discussed briefly. In an Appendix it is shown that the angle of slope of a surface of discontinuity should increase as a depression deepens, and that in consequence large-scale energy transformations are probably related mainly to converging and diverging movements over large areas, and only indirectly to surfaces of discontinuity. AUTHOR.

2641. Rainfall and Loss over the Vyrnwy Catchment Area. D. Lloyd. *Roy. Meteorolog. Soc., J.* 62. *pp.* 219–236; *Disc.*, 236–245, *April*, 1936.—Rain falling over a catchment area is partly recovered in stream flow. In specific periods, rainfall is equated to stream flow plus loss. The loss is affected by several causal agents. Consequently in periods of similar rainfall the resulting stream flow varies. The relation of stream flow to rainfall is deduced by analysing data from the Vyrnwy catchment area, where water is impounded by the Liverpool Corporation Water Undertaking. Records are available over a period of 50 years. Annual loss is correlated with associated rainfall and temperature data by a recent statistical method after M. Ezekial, which overcomes the inflexibility of Pearsonian methods. The functional effects of rainfall and temperature in terms of loss are described numerically and graphically. The percentage of the variance in loss due to differences in those causal agents suggests the reason why loss cannot be related to rainfall without taking into consideration other causal factors. The relations are produced descriptive of conditions at the area in a reservoired and an unreservoired state. AUTHOR.

2642. Blueness of the Sky. J. S. Farquharson. *Meteorolog. Office, Prof. Notes, No.* 70. [9 *pp.*] 1936.—Observations on the blueness of the sky made at three stations in England—Cattewater (Plymouth), Cranwell and Croydon, between June, 1926, and December, 1928, are discussed. The scale used was that on which zero means an absolutely white sky and 14 the deepest blue. The results are tabulated. At Cattewater the percentage of observations showing high scale numbers is greater than at the other two stations. This is probably due to its atmosphere being freer of industrial pollution. The average " blueness " at the various hours of observation for each month and also for the year is given in tabular form. A diurnal variation is found particularly in the winter months with a maximum about mid-day. There also appears a slight tendency for an annual variation to occur with a deeper blue in March and April. From the differences found in the results, the author concludes that there are two types of variation in the shade of blue of which Cattewater and Croydon are typical examples. A. E. M. G.

2643. Atmospheric Turbidity and Water Vapour Content. H. H. Kimball. *Monthly Weather Rev.* 64. *pp.* 1–5, *Jan.*, 1936.—The main object of the paper is to indicate the technique developed at Blue Hill for determining the atmospheric turbidity and water-vapour content. The instrument employed is an Eppley thermopile and by it the total energy in the solar spectrum or the energy in selected regions obtained by means of filters, is measured. The position in which the apparatus is located is first described. A chart from the Eppley is reproduced and a table gives the comparison between its recordings and those of a silver disc pyrheliometer. The method of computing β (turbidity coefficient) and w (water vapour content) from the Eppley record is outlined. The direct solar radiation intensities together with those obtained when the yellow and red filters are used are tabulated. From these and the transmission coefficients of the filters, β can be found and hence w computed. The paper is illustrated by photographs. A. E. M. G.

2644. Measurement of Schott Glass Filter Temperatures. R. F. Baker. *Monthly Weather Rev.* 64. *pp.* 5–6, *Jan.*, 1936.—The transmission of radiation through a filter which shows either selective or non-selective absorption is a function of the temperature. The author endeavours to find the temperatures that the filters on an Eppley thermopile assume so that a temperature correction may be applied. Thermocouples, previously calibrated, were used for this purpose, one junction being placed on the filter. Both filters were found to behave alike. The average increase of exposed filter temperature is found to be 1·4° C. in 3 min., *i.e.*, in the time the filter is exposed in routine measurements. Under normal conditions the shaded filter temperature may be taken as 1° C. above the air temperature. A. E. M. G.

2645. Photographic Penetration of Haze. Nora M. Mohler. *J.O.S.A.* 26. *pp.* 219–220, *May*, 1936.—Photographs taken with panchromatic and with infra-red plates yield visibility ratios which range from 1·1 for days with thick haze or light rain, to 1·7 for clear days (visibility 20 miles). These values indicate an upper limit of $0 \cdot 3\mu$ for the radius of drops in the thin haze. AUTHOR.

***2646. Rain Recorder. E. März.** *Zeits. f. Instrumentenk.* 56. *pp.* 167–170, *April*, 1936.—The instrument is devised for the express purpose of indicating the exact time at which the slightest rain has fallen. The manner in which the whole apparatus functions is given in detail. Various examples of records obtained are discussed. The paper is illustrated by schematic diagrams and reproductions of photographs of the apparatus. A. E. M. G.

SEISMOLOGY.

2647. Elastic Waves Formed by Local Stress Changes of Different Rapidities. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 10–17, *March*, 1936. *In English.*—Following on previous work [Abstracts 1004 and 1132 (1936)] it is now shown that if pressure were applied with some rapidity to a cavity, waves of the push type, *i.e.*, compressional waves, would be observed, whereas, if the pressure were released, waves of the pull type, *i.e.*, rarefactional waves, would result. W. A. R.

2648. Strains in an Elastic Solid. F. J. W. Whipple. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 380–388, *April*, 1936.—

The distribution of strain in a semi-infinite solid is discussed on the supposition that the solid is homogeneous, that there are no external forces and that the strains in the immediate neighbourhood of an internal nucleus are of a specified type. Formulæ are given for the displacements of the surface. It is found that elevation of the surface is associated with radial displacement outwards from a central point and depression with displacement inwards. The bearing of this theory on seismology is briefly discussed. [See Abstract 3818 (1935).] AUTHOR.

2649. Ellipticities of Strata of Equal Density within the Earth. K. E. Bullen. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **3.** *pp.* 395–401, *April,* 1936.—It is shown that on evidence now available it is possible to calculate the variation in density right through the earth to a fair degree of approximation. The analysis given confirms the existence of the new discontinuity at a depth of about 300 or 400 km. and indicates that there is in this region a density jump of probably about 0·5. The mean density of the core, 10·89, is found to be somewhat less than that previously estimated. The density and pressure at the earth's centre are found to be consistent with the existence of a central core of iron with little or no heavier metal present. Figures are given for densities and pressures at various depths and also for the ellipticities of surfaces of equal density. [See Abstract 2945 (1935).] AUTHOR.

See also Abstract 2814.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2650. Mobility of Small Ions of the Atmosphere. A. R. Hogg. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 31–59, 1936. *In English.*—The results of a series of observations of the mobility of the natural small ion are described. The measurements were carried out during 1934 at the Commonwealth Solar Observatory, Canberra. The mobility is obtained from a carefully controlled series of observations of conductivity and ion number made with the same apparatus. The average values corrected to air of normal density gave a value of 1·29 cm./sec./volt/cm. for the positive ion and 1·40 cm./sec./volt/cm. for the negative ion. A simple type of annual variation is found with a maximum in winter and a minimum in summer. The influences of such factors as humidity, intensity of solar radiation, age of the ions, etc., are investigated and the conclusion is reached that the observed variations in mobility are to be attributed partly to changes in the average life of the ion and partly to the presence in the lower atmosphere of varying amounts of gaseous impurities (probably oxidised nitrogen or ozone) in addition to water vapour. AUTHOR.

2651. Instability and Rupture of Droplets and Bubbles in Strong Electric Fields. L. Tonks. *Frank. Inst., J.* 221. *pp.* 613–620, *May,* 1936.—An approximate quantitative theory of the equilibrium of a bubble or droplet in a uniform electric field is developed and applied to earlier experimental results. An explanation of the oscillation of bubbles in strong fields and the difference in behaviour of positive and negative bubbles is explained on the basis of the discharge of electricity from points. [See also Abstract 3393 (1935).] AUTHOR.

2652. Austrian Jan Mayen Expedition in Polar Year 1932/33. R. Kanitscheider and M. Toperczer. *Akad. Wiss. Wien, Ber.* 144. 2*a.* 9–10. *pp.* 517–559, 1935.—The expedition sent out by the Academy of Sciences, Vienna, took up a position on the opposite side of the island from that occupied by the Austrian party in the first Polar Year, 1882/83.

There was an advantage in being near the Norwegian meteorological station on the island. The party consisted of three members who arrived on 22 June, 1932. The normal working of the place as a terrestrial magnetic station began in the last days of October. The party left the island on 5 Aug. 1933. Jan Mayen is 71° N and from 8° to 9° W. It is about 54 km. long and 12 km. at its broadest part. The new station was situated at the south foot of the Beerenberg, and the instruments were set up in two huts, one for the absolute apparatus and one for the recording instruments. The mean values found for the magnetic elements at the new station for the epoch 1933·0 were: D–21° 47′·2, H 11715 γ, Z 50335 γ, I 76° 54′·0. Those found for the old station were: D –21° 20′·3, H 9430, Z 50094, I 79° 19′·8 for June, 1933; Gratzl found for June, 1883, D –29° 50′·1, H 9765, Z 50288, I 79° 0′·7. The values found are not regarded as representative, but are to be considered as affected by local disturbances of unknown amount. Tables of monthly means, daily values and activity values are appended. G. E. A.

***2653. Vertical-Intensity Variometers of the Knife-Edge Type. G. Hartnell.** *Terr. Mag.* 41. *pp.* 65–73, *March*, 1936.—Four Z-variometers of the knife-edge type were operated simultaneously at the Cheltenham Magnetic Observatory for six weeks in 1935. Their relative performance was determined by comparing the ordinates for four periods of one hour for each day. The results indicate that variometers of this type, carefully designed and of superior workmanship, can be operated satisfactorily for observatory purposes, if they are kept free from mechanical jars and the supporting surfaces are kept clean. AUTHOR.

2654. Solar Activity and the Diurnal Amplitude of North-South Earth Currents. P. Rougerie. *Comptes Rendus*, 202. *pp.* 967–968, *March* 16, 1936.—Data used for this investigation are obtained from hourly means for the month of the p.d. observed over the period 1910–1933. The curve representing the diurnal amplitude of earth currents shows a similarity to that obtained with the aid of Wolf and Wolfer numbers for solar activity. The current amplitudes have also been submitted to harmonic analysis, and components of several different periods isolated. The greater part of the components correspond to components of nearly the same periods for sunspots. The author concludes that there is a striking analogy between the development of sunspots and the variation of the diurnal amplitude of N-S earth currents at Tortosa. The results, while pointing out the correlation, do not claim to explain the cause of it in any way. A. E. M. G.

RADIOACTIVITY.

2655. Separation of Radioactive Atoms from Isotopic Stable Atoms. O. Erbacher and K. Philipp. *Zeits. f. phys. Chem.* 176. *Abt. A.* 3. *pp.* 169–181, 1936.—The radioactive atomic species of halogens, which arise during the irradiation of non-ionised organic halogeno-compounds with neutrons, are in the ionic condition. If the organic halogeno-compound be carefully purified prior to the irradiation, then by subsequent extraction with water a solution may be obtained which contains only the radioactive halogen ion alongside an amount of the original product corresponding to its solubility in water, and the latter may be completely removed by benzene extraction. In this manner an aqueous solution is produced which, as may be readily tested for the case of Br, only contains the radioactive halogen in amount corresponding to 10^{-17} of the initial halogen product irradiated. Comprehensive experimental details are included. H. H. Ho.

2656. Adsorption of Radon by Glass. S. C. Lind and R. Livingston. *J. Phys. Chem.* 40. *pp.* 419–420, *March*, 1936.—Experiments in which Rn is sealed for long periods in pyrex bulbs show that a considerable fraction of the gas is adsorbed in the glass; in some cases, after periods of 48 hr. or more, almost 20 % of the Rn may be adsorbed. The data suggest that the percentage adsorption depends in some way on the time of contact. It is possible that the adsorption is due to " pitting " of the glass by α-particle bombardment. These experiments indicate the necessity of additional precautions in the handling of Rn in radiochemical experiments; the gas should be kept in glass containers for the minimum possible time. J. E. R.

2657. Preparation and Purification of Titanium-Protactinium. (Mrs.) Emmanuel-Zavizziano. *Comptes Rendus*, 202. *pp.* 1052–1054, *March* 23, 1936.—Details are given of the chemical and radioactive purification of a Ti-Pa preparation obtained from a mineral (pitchblende) solution and of the subsequent concentration of the preparation. W. E. P.

2658. Distribution of ThC″ in Solutions of Thallium Salts. J. Zirkler. *Zeits. f. Physik*, 99. 9–10. *pp.* 669–670, 1936.—The 70/30 ratio of the amounts of γ-activity associated with mono- and tri-valent Tl [see Abstract 591 (1936)] is verified by numerous experiments in which the Tl^{I}/Tl^{III} ratio varied from 0·1 to 2·17. C. A. S.

2659. Radiochemical Synthesis and Decomposition of Hydrogen Bromide. S. C. Lind and R. Livingston. *Am. Chem. Soc., J.* 58. *pp.* 612–617, *April*, 1936.—The rate of the radiochemical synthesis and decomposition of HBr is determined for various mixtures of H_2, Br_2 and HBr. Since none of the existing theories of radiochemical reactions appear to be compatible with the data presented here, a modified cluster theory is proposed which is consistent with the measurements. A relation between the ion pair yield and the initial pressures of the reactants is developed on the basis of the proposed theory. An integrated equation relating the change in pressure to the duration of the experiment and its initial conditions is derived. It is shown that the experimental data are in satisfactory agreement with the equations. Earlier experiments are discussed in the light of the new theory. AUTHORS.

2660. Radioactivity of Rocks. H. Jeffreys. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 149–171, 1936. *In English.*—Some 350 determinations of Ra and 200 of Th content of different varieties of rock are examined critically and their probable accuracy discussed. The nature and possible causes for variations are discussed, giving some support to the view that in the original magmas the olivine first crystallised out, and the alkalies concentrated in the residual (and upper) liquid formed granite, the radioactive elements tending to accompany potassium. C. A. S.

2661. Tracks of α-Particles of Thorium and its Products. H. J. Taylor and V. D. Dabholkar. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 265–271, *March*, 1936.—The tracks of the α-particles from members of the Th series are recorded in a photographic emulsion, by the use of a technique previously developed [see Abstract 934 (1936)]. Radiothorium atoms introduced into the emulsion disintegrate *in situ*, emitting five α-particles in succession. In this way " stars " are produced, consisting of five tracks radiating from a point, of which a discussion is given. Photomicrographs of two " stars " are reproduced. AUTHORS.

2662. Intensities of Fine Structure Groups in Magnetic Spectra of Radioactinium and its Disintegration Products. S. Rosenblum, M. Guillot and Marguerite Perey. *Comptes Rendus*, 202. *pp.* 1274–1276, *April* 6, 1936.—With the arrangement previously described [see Abstract 2931 (1933)] and the Bellevue magnet the α-magnetic spectra of RdAc and its products have been observed. The results are shown by curves and indicate the following intensities :

	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8	α_9	α_{10}
RdAc ...	16	1	13	1	2	3	2	15	1	12	2(?)
AcX	12	10	5	2	—	—	—	—	—	—	—
An	18	4	3	1	—	—	—	—	—	—	—
AcC	17	5	—	—	—	—	—	—	—	—	—

New lines were found attributed to AcX and An with energies of 280 and 610 ekV respectively. α_0 of AcX has energy 5–10 ekV > that of α_0 of RdAc. C. A. S.

2663. Continuous β-Ray Spectrum of RaC″. L. Goldstein and M. Lecoin. *Comptes Rendus*, 202. *pp.* 1169–1170, *March* 30, 1936.—Using sources of RaC″ prepared by recoil on to a cellophane surface from a RaC source, the continuous β-ray spectrum of RaC″ is examined with an expansion chamber. From a total number of 650 tracks the mean energy is estimated as $4 \cdot 7 \times 10^5$ eV. Conservation of energy in the two branches RaC, RaC′, RaD and RaC, RaC″, RaD appears to demand at least two quanta of total energy 34×10^5 eV at each disintegration.

F. C. C.

2664. Theory of β-Disintegration. H. Yukawa and S. Sakata. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 128–130, *March*, 1936. *In English.*—The probability of the K electron absorption of the nucleus is calculated according to the modified theory of Konopinski and Uhlenbeck [see Abstract 3410 (1935)] instead of Fermi's theory. No essential difference in results is found. [See Abstract 595 (1936).] AUTHORS.

2665. Energy Distribution of Recoil Atoms during β-Decay: Existence of Neutrino. A. I. Leipunski. *Cambridge Phil. Soc., Proc.* 32. *pp.* 301–303, *May*, 1936.—Positive recoil ions from ^{11}C were analysed by suitably varying a retarding potential, *v*, applied between the plate (on which ^{11}C, as ^{11}CO or $^{11}CO_2$, was adsorbed) and a grid. Those which passed the grid were accelerated to 5000 eV and then struck a metallic mirror, whence they ejected electrons which were counted in a Geiger counter. From the numbers with varying values of *v* an energy distribution curve for the recoil atoms was obtained. This shows their energy to be considerably greater than would have been expected without neutrinos, but the results are not sufficiently accurate to allow of more being stated with certainty than that they favour the theory of emission of neutrinos in β-decay. C. A. S.

2666. Excitation of γ-Rays by Neutrons. Part III. S. Kikuchi, H. Aoki and K. Husimi. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 115–127, *March,* 1936. *In English.*—The emission of γ-rays from numerous substances traversed by fast neutrons (2 eMV) is confirmed, and the relative cross-sections of the effect are determined for 32 elements. The absolute value of the cross-sections can only be estimated very roughly and may probably be of the order of 5×10^{-25} cm.^{2} for Cu. For six elements, Sn, Cd, Zn, Cu, Ni, and Fe, which emit γ-rays most abundantly, the quantum energies of the radiations are determined by the absorption curve of secondary electrons using the usual method of coincidence of two counters. They are all of very similar character and though the energy of most of the secondary electrons lies under the kinetic energy of the primary neutrons there were some indications of the presence of harder components. Absorption of secondary electrons due to γ-rays excited by slow neutrons is also obtained for the above six elements. In every case, except Sn, the rays are distinctly harder in the case of slow neutrons. [For Part II see Abstract 1583 (1936).] AUTHORS.

2667. γ-Ray Diffraction Pattern. H. Seemann. *Phys. Zeits.* 37. *pp.* 345–347, *May* 1, 1936.—The experiment of Rutherford and Andrade, in which an interference pattern is obtained by the diffraction of the γ-rays from Ra by a rock-salt plate, is repeated. The pattern obtained is an incomplete Quenstedt linear projection of the rock-salt lattice. J. T.

2668. Radioactivity and Atomic Theory. (Lord) Rutherford. *Chem. Soc. J. pp.* 508–516, *April,* 1936. *Faraday Lecture.*—The progress of radioactivity is traced from the first discoveries. An account is given of the investigations leading to the law of radioactive disintegrations, and then of the various theories regarding atomic and nuclear constitution, the X-ray spectra of the elements, isotopes and transmutations effected first by naturally produced α-particles, and then by artificially produced and accelerated protons, deutons and neutrons (fast and slow), with the inferences deducible regarding atomic masses, and the energy emitted as γ-rays. C. A. S.

See also Abstracts 2467, 2468, 2838, 2901.

RADIATION.

ABSORPTION AND TRANSMISSION.

2669. Transmissivity and Reflecting Power of Thin Layers of Silver from the Infra-Red to the Ultra-Violet. F. Goos. *Zeits. f. Physik,* 100. 1–2. *pp.* 95–112, 1936.—Films of Ag, from 0·8 to 142 mμ thick, are deposited on quartz and the transmissivity and reflectivity investigated from the air and from the quartz side. In this way it is possible to estimate the mass of the Ag. The constants of Ag are determined and certain conclusions regarding the structure of the films are drawn. W. R. A.

2670. Isolation of the 4358 Å Mercury Triplet for Excitation of Raman Spectra. C. Sannié, L. Amy and V. Poremski. *Comptes Rendus,* 202. *pp.* 1042–1044, *March* 23, 1936.—By using *m*–dinitrobenzene to cut off shorter waves and simultaneously rhodamine 5 G *extra* (dimethyl diamino-*o*-chlorodiphenyl dimethyl xanthyl chloride) to absorb longer waves the 4358 Å triplet can be used to give Raman spectra without the usual complications arising. W. R. A.

2671. Absorption of Light and the Trapping of Electrons and Positive Holes in Crystalline Dielectrics. J. Frenkel. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 158–186, 1936. *In English.*—Light-absorption in a crystalline dielectric can produce excitation without ionisation, the resulting formation of an " exciton " being accompanied by the absorption or emission of a " phonon " and transfer of momentum to the crystal lattice. The " trapping " characteristic of dielectrics and semiconductors can be explained by the application of similar considerations to electrons and positive holes in an optically ionised crystal. The general principles of the theory are quantitatively formulated, and Peierl's theory is criticised. J. S. G. T.

See also Abstract 2700.

COLORIMETRY.

✱2672. Apparatus for Sugar Colorimetry. J. F. Brewster. *Bureau of Standards, J. of Research,* 16. *pp.* 349–358, *April,* 1936.—The apparatus consists of a Duboscq colorimeter and an incandescent light source with suitable spectral filters and glass photometric standards for the measurement of absorbency in sugar solutions. The absorbency of all except very pale solutions, may be determined at 560 mμ by using a special yellow-green filter. Solutions of high-grade sugar products having little colour are treated as a special case, and using a blue filter, measurements are made at 460 mμ. The results obtainable are satisfactory for technical purposes. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2673. Electro-Optical Kerr Effect in Methane, Ethylene and Ethane. W. M. Breazeale. *Phys. Rev.* 49. *pp.* 625–626, *April* 15, 1936.—The Kerr effect is measured in methane, ethylene, and ethane. The measurements are made at a wave-length of 6500 Å, pressures from 30 to 100 atmospheres and temperatures from 15 to 55° C. With the aid of the Langevin-Born theory absolute values for the Kerr constant at

N.T.P. and 6500 Å are deduced from these measurements. The values are: for methane $3{\cdot}66 \times 10^{-12}$, for ethylene $16{\cdot}3 \times 10^{-12}$, and for ethane $10{\cdot}4 \times 10^{-12}$. These are in fair agreement with theoretical values computed from the Langevin-Born theory. AUTHOR.

2674. Dispersion of the Magnetic Rotation of Liquid Mixtures. H. Poltz. *Zeits. f. phys. Chem.* 32. *Abt.B.* 4. *pp.* 243–273, 1936.—The magnetic rotation for the visible region and as far into the ultra-violet as possible is described on eight organic liquid binary mixtures over the whole concentration region. Determinations of the density and refractive index are also described for the visible region only, and the results are recorded for various wave-lengths in a series of tables. The validity of the mixture rule is examined. The results are discussed from the point of view of the relationship between intermolecular forces and magnetic rotation in solution, and a tentative theoretical explanation is put forward for the relation between the magnetic rotation and the refractive index. R. L.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2675. Quenching of Fluorescence of Dye Solutions by Foreign Substances. Part I. B. Sveshnikoff. *Acta Physicochimica,* 4. 3. *pp.* 453–470, 1936. *In English.*—The quenching of fluorescence treated as a decrease of efficiency is due in many cases to the deactivation of excited molecules through collisions of the second kind. The principal criterion as to whether or not the considered case of quenching is produced by collisions of the second kind, is the increase of polarisation due to quenching. By measuring polarisation it may be ascertained whether the factor of static quenching exists or not. The experimental results show that in all cases investigated by the author the factor of static quenching is absent or, more exactly, that the quenching action is in all cases produced by factors depending on time. In many cases where the quenching is due to deactivation through collisions of the second kind, a formula given in the paper interprets satisfactorily enough the data obtained. It is clearly shown that quenching action is independent of the wave-length of the exciting light, but some quenchers exercise a selective action on some dyes. AUTHOR.

2676. Inhibiting Action of Alkaloids on the Fluorescence of Uranine Solutions. A. Boutaric and J. Bouchard. *Ann. Soc. Sci. de Bruxelles,* 56. *pp.* 35–40, *April* 3, 1936.—It appeared from previous work that the fluorescence-inhibiting power of antioxygen substances is quite general. The effects of a number of alkaloids on the fluorescence of uranine solutions is studied to see whether these alkaloids are antioxygen substances. The results gave an affirmative answer. It is suggested that the antithermal action of these alkaloids as medicaments is closely connected with their antioxygen properties, which tend to reduce oxidation processes in an organism. Polonovsky and Nitzberg have shown that alkaloids possessing an amine radical may be transformed into amino oxides which have almost the same therapeutic action as the alkaloids without their toxic properties. The authors have therefore examined these genalkaloids for antioxygen properties in the inhibition of fluorescence. The results show that there is a marked difference in this respect between the alkaloids and the genalkaloids, the latter not showing inhibiting properties. It is considered that the absence of antioxygen properties of genalkaloids is linked to the absence of toxic properties. J. E.

2677. Fluorescence of Porphyrins. Part II. A. Stern and H. Molvig. *Zeits. f. phys. Chem.* 176. *Abt.A.* 3. *pp.* 209–225, 1936.—Continuing previous work [see Abstract 609 (1936)], the fluorescence spectra of a number of porphyrins are determined in dioxane. It is found that an increase in the number of substituents in the porphin system causes displacements of the maxima of the fluorescence bands which are not always in the same direction as the corresponding displacements of the maxima of the absorption bands. The use of the regularities of the fluorescence spectra as a means of investigating the structure of the molecules is discussed with examples. The conclusions as to structure which had been arrived at from studies of absorption spectra [see Abstract 2219 (1936)] are supported by consideration of the relationships between the fluorescence spectra of the pyrromethenes and the porphyrins in the solid state and between the fluorescence spectra of the porphyrins in neutral media and in aqueous HCl. L. A. W.

2678. Fluorescence of Platinocyanides. J. A. Khvostikov. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 210–236, 1936. *In German.*—The fluorescence of platinocyanides (especially the K salt) in solution is demonstrated and its properties investigated. The fluorescence is polarised to a degree which varies with the viscosity of the solvent in accordance with the Perrin formula. Aniline has a quenching effect, which is accompanied by an increase in the degree of polarisation. No concentration-quenching is detected. The absolute fluorescence yield (ratio of emitted to absorbed energy) for potassium platinocyanide is found to be $4\frac{1}{2}$ %. The duration of the excited state is $2 \cdot 5 \times 10^{-10}$ sec., the calculated value in absence of quenching being $5 \cdot 6 \times 10^{-9}$ sec. The dependence of fluorescence yield upon temperature (negative coefficient) and upon wave-length of the exciting light is investigated. The curve expressing degree of polarisation as a function of wave-length of the exciting light shows a marked maximum. L. A. W.

2679. Phosphorescent Beryllium Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 627. *pp.* 41–46, *April,* 1936. *In English.*—It is found that beryllium nitride becomes phosphorescent when small quantities of Al, B, C or Si are added to it, the maximum effect being obtained with Al. The kathode-ray spectrum of the activated beryllium nitride is found to consist of a continuum from $\lambda 4200$ to $\lambda 4900$, with a maximum at $\lambda 4650$. A. H.

2680. Weak Ultra-Violet Phosphorescence Intensities by Photo-Counter Tube Method. M. L. Katz. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 254–258, 1936. *In German.*—The author demonstrates that the photo-counter tube may be employed for the investigation of weak u.v. phosphorescence, since for extremely weak intensities the photographic method has failed. It has been found that the photo-counter tube enables phosphorescence intensities to be observed which are 2000-times weaker than can be examined by the best photo-cell arrangement. Full details are given of the investigation of the u.v. phosphorescence of blue fluorspar, whereby an extremely characteristic anti-Stokes phenomenon is established; the emitted phosphorescent radiation has a shorter wave by more than 1000° Å than that of the exciting light. H. H. Ho.

***2681. Vacuum-Cell Luminescence Microscope and Its Use in the Study of Luminescent Materials. J. Gallup.** *J.O.S.A.* 26. *pp.* 213–215, *May,* 1936.—A new type of luminescence microscope is described. Its use in the examination and comparison of materials luminescing under electron bombardment *in vacuo* is explained. Fields of self-luminous particles are obtained of sufficient brightness to permit of satisfactory visual observation at magnifications up to 500 ×. Good photomicrographs can be made at 100 × with ordinary film. In the study of managnese-activated calcium silicates, this microscope has facilitated the determination of many of the relationships which exist between colour of luminescence, intensity of luminescence and crystal form. The low temperature form of calcium metasilicate luminesces more brightly than any other calcium silicate studied. A thorough wet mixing of raw materials is necessary to obtain a product of uniform luminescence. AUTHOR.

See also Abstract 2826.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2682. Diffraction. G. Green. *Phil. Mag.* 21. *pp.* 934–947, *May*, 1936.—A mathematical discussion is given of a problem for which an approximate solution was first suggested by the late Lord Rayleigh—plane waves being incident normally upon a plane screen pierced by a small circular aperture, to determine the resultant wave motion on either side of the screen. The problem is of importance both in sound and in optics, and is here for convenience studied as a problem in heat conduction. A. H.

2683. Scattering of Light in Optical Glasses. R. S. Krishnan. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 211–220, *March*, 1936.—A study is made of the intensity and state of polarisation of the light scattered transversely by a number of glasses with the incident light in different states of polarisation. Weak fluorescence is observed in all the glasses. Measurements of the depolarisation factors ρ_u, ρ_v and ρ_h are made with an orange filter in the path of the incident beam to eliminate fluorescence. ρ_u and ρ_v are found to be of the same order of magnitude as are usually observed in the case of gases. On the other hand, ρ_h is found to be distinctly less than 100 %, showing the existence of molecular aggregates of size not small compared with the wave-length of light. Since no visible inclusions are observed it is concluded that the scattering is really an internal phenomenon. Measurements of relative intensity of scattering in these glasses are made employing a photoelectric method. The influence of composition on the formation and size of the molecular aggregates formed is discussed. It is found that the tendency for the formation of molecular aggregates increases with increasing percentage of acidic oxides, especially boric oxide, whereas it diminishes when the glass gets more basic. A. H.

See also Abstracts 2804, 2805.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2684. Properties of Illuminated Iodine Solutions. Part II. Negative Absorption Effect in Benzene and Other Solvents. E. Rabinowitch and W. C. Wood. *Faraday Soc., Trans.* 32. *pp.* 816–823, *May*, 1936.—Iodine solutions in C_6H_6, CH_3OH, and H_2O, illuminated by the light from a 1500 W carbon arc, show a reversible increase in their extinction coefficient during illumination. Exact measurements of this effect in a benzene solution show it to be proportional to the square root of light intensity, and independent of iodine concentration (for constant number of quanta absorbed). In I_2 solutions in CCl_4/C_6H_6-mixtures, the effect is proportional to the concentration of benzene. Two explanations are offered for the occurrence of this " negative" effect—one assuming a destruction of complexes (*e.g.*, $C_6H_6 \cdot I_2$) by light, the other the formation of new complexes (*e.g.*, $C_6H_6 \cdot I$, or $C_6H_6 \cdot I_3$) during illumination. The first appears to be the more plausible, but the second is the only one which readily accounts for the above-mentioned experimental laws. [For Part I see Abstract 1604 (1936).] AUTHOR.

2685. Blackening of Photographic Plates under the Influence of Positive Ions. L. M. Nemenov. *Phys. Zeits. d. Sowjetunion*, 9. 2–3. *pp.* 132–139, 1936. *In English.*—The photographic effect of positive Li ions for energies up to 5000 eV is investigated. For energies of 5000 eV the sensitivity of " Schumann " plates differs very little from that of " Q " plates. In general, however, the degree of blackening of the " Schumann " plates, owing to the greater thickness of their sensitive layer, depends to a greater degree upon the energy of the ions than is the case with " Q " plates. J. S. G. T.

2686. Objective Measurements of Graininess of Photographic Materials. A. van Kreveld. *J.O.S.A.* 26. *pp.* 170–176, *April*, 1936.—Deals with the practical realisation of the measurements as far as graininess is concerned, the present author having already described a general theoretical basis for expressing and measuring the graininess and resolving power of photographic emulsions with respect to their different applications. [See Abstract 684 (1935).] After a brief preliminary consideration of the practical graininess, the results of experiments on the average deviation from the density are given, these showing that the fluctuations of the density are caused by silver grains only and that registrograms of homogeneous black areas are Gaussian error curves. The graininess meter is then described, and the results obtained from the first series of measurements with the meter using different emulsions and developers are briefly dealt with. These show that metol developer causes a higher sensitivity and a somewhat lower relative deviation from the intensity than does hydroquinone developer, that the average deviation from the density expressed as a function of the density has a maximum at a density of about 0·3 to 0·6, and that the relative deviation from the intensity decreases with increasing density. R. C. F.

2687. Photographic Behaviour of Colloid-Free AgBr Layers. G. Ollendorff and R. Rhodius. *Zeits. f. wiss. Phot.* 35. *pp.* 81–118, *April–May*, 1936.—Describes the results of experiments performed with gelatin-free AgBr layers, an improved method of deriving these layers with positive and negative charges being given. The sensitivity of such layers is only 1/30 to 1/300 of the highest sensitivity commercial film. Blackening curves of positive, negative and iso-electric layers are the same as for the gelatin layer in each case, and show the solarisation phenomena with correspondingly higher illumination values. A metol developer giving fog-free pictures is used in every case, the pH values being 8·7 for iso-electric AgBr obtained from a − sol and for − AgBr, and 7·4 for + and iso-electric AgBr from + sol, the retarding of the reducing action of gelatin found by previous authors being supported by the results obtained. The retarding and accelerating action of materials on the reduction of un-illuminated AgBr is shown to agree with the adsorption theory of Rabinowitsch [see Abstract 4519 (1934)]. The effects of adsorbed crystalloids and colloids on the sensitivity are then examined, the action being dependent on whether they are operating on iso-electric AgBr produced from

+ or − sols. Spectral sensitivity of the + AgBr in the long wave-length region is higher than that of the − AgBr or of the iso-electric AgBr from − sol. Finally, the action of various substances on the latent image, and the different desensitising actions of several dyes on + and − AgBr are examined. [See following Abstract.] R. C. F.

2688. Retarders and Accelerators for the Reduction of Silver Salts. G. Ollendorff and H. Andresen. *Zeits. f. wiss. Phot.* 35. *pp.* 119–123, *April–May,* 1936.—Describes a number of pure chemical reactions of silver salts, dealing particularly with AgBr. These salts can be reduced instantaneously by developers in the absence of colloids if not illuminated, but the reducing action is delayed by gelatin and a number of other materials, and by decreasing the pH value of the developer. Acceleration of the reduction process is obtained by the addition of KI, Na_2S, thiosulphate, thiosinamin and small quantities of mixtures of Cu and Hg salts. [See preceding Abstract.] R. C. F.

2689. Statistical Distribution of Absorbed Light Quanta among the Grains of a Photographic Film. G. Ungar. *Zeits. f. Physik,* 99. 9–10. *pp.* 688–694, 1936.—The distribution of absorbed light quanta among the grains of a one-grain film is put equal to the statistical distribution of light quanta among large groups of cells of the quantum gas, and it is then shown that this distribution can be represented by the Poisson equation. In calculating blackening curves, the variations of the distribution can be neglected and the number of quanta absorbed by each grain put equal to the mean value. Only at threshold values of blackening must the " fine distribution " of the quanta be taken into account. [See Abstract 1171 (1936).] C. B. A.

2690. Bichromate Gelatins. Part II. E. Elöd and H. Berczeli. *Kolloid Zeits.* 75. *pp.* 66–74, *April,* 1936.—This paper continues the work of Part I [see Abstract 2157 (1936)] and by means of the evaluation of the rate of solution and apparent light sensitivity the author investigates the influence of the average micellar dimensions and the possible impurities in the gelatin (such as decomposition products) upon the bichromate-gelatin process. By disintegration of the gelatin at 100°, the rate of solution appears to be reduced to a characteristic value for each gelatin. Further disaggregation brings about the loss of typical gelatin properties such as power of gelatinisation, and thus the rate of solution appears to be primarily dependent on the experimental conditions. The solubility of gelatin films is also investigated. The dark tanning of the gelatin is reduced by disintegration, and the apparent light sensitivity of the films is thereby considerably lowered. It is concluded that rate of solution and apparent light sensitivity are properties such that conditions which promote one of them in a desired direction have the reverse effect on the other. H. H. Ho.

2691. Desensitisation Theory. K. Weber. *Zeits. f. wiss. Phot.* 35. *pp.* 124–128, *April–May,* 1936.—Discusses recently published results of other authors, from the point of view of the theoretical significance of the desensitisation of photographic emulsions by dyes, and shows that they support conclusions previously obtained by the present author. Several reaction formulæ are also developed, relating only to the optically sensitised part of photographic processes. R. C. F.

***2692. High-Speed Photography. H. E. Edgerton, K. J. Germeshausen and H. E. Grier.** *Phot. J.* 76. *pp.* 198–204, *April,* 1936.—Briefly describes a method of high-speed photography developed for the study of oscillations of synchronous motors following changes in load and during the transient period of the motor as it endeavours to pull into synchronism. The control of the illumination, which is obtained from discharge tubes, is by means of electronic amplifiers, these consisting of a condenser, induction coil and grid-controlled mercury-arc rectifier. The grid of the rectifier is actuated by a commutator on the camera, thereby spacing the pictures correctly. A speed of 1200 pictures per sec. is obtainable with full-frame 35 mm. pictures, capable of increase up to 6000 per sec. by reducing the frame size. R. C. F.

2693. Kodachrome Process of 16 mm. Colour Kinematography. E. R. Davies. *Phot. J.* 76. *pp.* 248–253, *April*, 1936.—Describes the new colour process which has the simplicity of black and white photography, the film consisting of 5 separate coatings which together are no thicker than the ordinary film. It is a subtractive colour process in which three of the five superimposed layers are sensitised to the three primary colours, thus causing the colour separation to be made automatically during exposure. The layer next to the base has only a low sensitivity to green light and its response to green can be further reduced by incorporating a suitable dye in the thin layer of gelatin over it. Next comes an emulsion layer sensitive to blue and green, but only green light affects this layer because of a yellow dye in the gelatin layer above it, and finally on top is an unsensitised emulsion which records the blue component of the incident light. The processing of the developed film is performed in seven stages and during these stages the emulsions are changed into dyed layers, the colours being blue-green, magenta and yellow. The change from latent into dye images is obtained by means of coupling developers, their action being carefully controlled so that after the bottom or blue-green layer is obtained it is not allowed to be affected by succeeding stages, which are alternately bleaching and developing. The finished film is one in which the definition is extremely good, the scattering very slight and the resolution unaffected by the slight spreading of the dyes. R. C. F.

***2694. Surgical Photography in the Operating Room. H. S. Hayden.** *Phot. J.* 76. *pp.* 205–209, *April*, 1936.—The need for photographic records of critically clear details of neurosurgery have given rise to the development of a special technique eminently suited to the production of photographs taken during operations. Photographic difficulties have, to a large extent, been removed by recent developments in the manufacture of emulsions, but the mechanical difficulties—effective screening of photographer and his equipment from the sterile field, obtaining of critically defined images of the operating area, adjustment of apparatus to give a wide range of viewing angles without delay, and sealing off of the apparatus—are not so easily overcome. The author describes in detail the equipment in use at Montreal, where the photographer's room with camera and controls is placed beneath the visiting surgeon's gallery and can be shut off from operating theatre by means of a sliding window, a silver surface mirror being used to the view the necessary area. R. C. F.

2695. Photography in Research on Cotton Textiles. C. W. Bradley. *Phot. J.* 76. *pp.* 210–216, *April*, 1936.—Gives an outline of the main uses to which photography has been applied by the British Cotton Industry Research Association. After dealing briefly with the use of photomicrographs for the illustration of hair characteristics, the way in which defects can definitely be traced to a certain process during manufacture by comparison with photomicrographs is described. In connection with researches on starches and antiseptics photography has proved useful, and X-ray photography is also valuable in dealing with modifications of complex materials like cellulose. Finally, the effectiveness of high-speed photography as an aid to the examination of moving parts of textile machinery is mentioned. R. C. F.

***2696. Photography by Polarised Light. J. W. McFarlane.** *Phot. J.* 76. *pp.* 217–223, *April*, 1936.—Deals with the uses of pola-screens in photography, in which such screens can serve as a variable-depth filter for dark sky effects, if applied over lens only, or when applied to lens and light have special applications in the copying and reproduction of subjects. After briefly describing how light is polarised, the usefulness of polarised light for photographic purposes is discussed. The paper concludes with a number of short paragraphs enumerating the present uses of polarised light in photography, the list being divided into two parts—for the pola-screen over lens only, and over both lens and lights. R. C. F.

***2697. Methods of Stereophotomicrography. J. R. Baker.** *Phot. J.* 76. *pp.* 275–279, *May*, 1936.—A special tilting stage is described, by means of which it is possible to make truly stereoscopic photographs with high, medium or low powers of the microscope. The object is photographed, rotated through 15° about an axis at right angles to the optical axis of the microscope, and then re-photographed. The photographs are viewed by approximately parallel vision through an ordinary stereoscope. AUTHOR.

2698. New Photographic Process. K. M. Kosonogova. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 4. *pp.* 167–168, 1936. *In German.*—Briefly describes a new photo-electrochemical process which is capable of giving photographic images but only after electrochemical polarisation. Cu electrodes coated with CuI are illuminated and then kathodically polarised in a $Pb(NO_3)_2$ solution. At a potential of 0·3 V below the natural electrode potential the illuminated parts change colour from white to green. The light action is appreciably increased by colouring the electrode by means of dyes. R. C. F.

See also Abstracts 2496, 2579, 2580, 2645.

POLARISATION.

2699. Anisotropy of the Optical Polarisation Field in Liquids. Parts I and II. B. S. R. Rao. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 240–248, *March*, 1936.—The molecular refractivity is found to increase with temperature in CS_2, C_6H_6 and C_6H_{14} liquids but remains constant in the case of CCl_4. The anisotropic constants are calculated for the first three substances and it is found that the polarisation field becomes more and more isotropic with increasing temperature. From these constants the dependence on temperature of the depolarisation of scattered light in these liquids is also deduced and compared with experimental data. Evidence is also given supporting the view that the optical polarisation field in CCl_4 is isotropic. A. H.

2700. Optical Properties of Halogen Derivatives of Camphor. J. P. Mathieu and J. Perrichet. *J. de Physique et le Radium*, 7. *pp.* 138–140, *March*, 1936.—A study is given of the absorption, rotation and circular dichroism between 650 mμ and 250 mμ of the compounds α-chloro-, α-bromo-, αα dichloro- and αα dibromocamphor. There exists a band of absorption which possesses a strong Cotton effect, but the circular dichroism does not pass through a maximum at the same time as the absorption. J. J. S.

2701. Polarisation of Line 2139 Å Emitted by a Jet of Zinc Atoms. P. Soleillet and S. Nikitine. *Comptes Rendus*, 202. *pp.* 1046–1047, *March* 23, 1936.—The imperfect polarisation seems to indicate that the number of isotopes of zinc is different from the usually accepted number. W. R. A.

See also Abstracts 2683, 2696, 2755.

RADIATION, EMISSION.

2702. Deductions from the New Non-Linear Electrodynamics. B. Kwal and J. Solomon. *Comptes Rendus*, 202. *pp.* 933–934, *March* 16, 1936.—Using expressions for the energy density and the pressure of radiation given by the Born-Infeld non-linear electrodynamics, the author applies the usual thermodynamic argument to determine the total energy density of radiation associated with a black body at a given temperature. Stefan's formula is found to become, to a first approximation, $\sigma T^4(1 + 14\sigma\pi T^4/b^2)$ where b is the special constant of the Born-Infeld theory. The additional term is appreciable only at temperatures above about 10^9 °Abs. W. S. S.

***2703. Radiant Energy Receiver. H. V. Hayes.** *Rev. Sci. Instruments*, 7. *pp.* 202–204, *May*, 1936.—Describes a device to be actuated by impulses of radiant energy in the form of light or heat. The impulses may succeed each other with a frequency of one or more a second. Use is made of a finely divided gas occluding substance confined in a hermetically sealed chamber, one side of which is a thin metal diaphragm forming a portion of a condenser receiver. When light or heat falls upon this substance the gas within the chamber expands and changes the capacitance of the condenser receiver. When the device receives an impulse of radiation, it shows a sensitivity of more than 50V/W/cm^2. [See following Abstract.] AUTHOR.

***2704. Radiant Energy Measurement. W. M. Hall.** *Rev. Sci. Instruments*, 7. *pp.* 205–206, *May*, 1936.—If the above receiver [see preceding Abstract] is to be used for measurement purposes it is desirable that there be no lower frequency limit to the amplifier response, so that the indication of change in radiation received will be independent of the rate of change. One solution of this problem is to use an a.c. bridge one arm of which consists of the capacitance of the receiver. Such a bridge circuit is described. AUTHOR.

2705. Ring and Disc Sources. G. Green. *Phil. Mag*. 21. *pp.* 922–934, *May*, 1936.—This entirely mathematical paper is devoted to the radiation of heat from periodic sources of various forms. The results may be applied with small alterations to the radiation of sound. The following periodic sources are dealt with: circular line, spherical surface, cylindrical surface, infinite plane, disc. The following instantaneous sources are also discussed: circular line, cylindrical surface and plane surface. A continuous circular line source is also dealt with. J. E. R. C.

2706. Nature and Range of the Particles Causing Hoffmann Collisions. H. Nie. *Zeits. f. Physik*, 99. 7–8. *pp.* 453–480, 1936.—Using the rotating condenser compensation method of Steinke and Gastell, Hoffmann collisions are examined under different screening conditions of the ionisation chamber. Directional measurements show great differences when carried out in the neighbourhood of different substances. For a few arrangements of the chamber, the Hoffmann effect is observed with screens ranging from zero thickness to within 10 % of that required for the optimum effect. The maximum effect occurs at 4–5 cm. for Pb, 10–15 cm. for Fe and more than 50 cm. for Al, the average collision being larger for Pb than for Fe. Very little change in the magnitude of the collision is observed with increasing thickness. The contributions of different parts of the screen are examined and it is shown that by far the greater part of the primary radiation is incident in a vertical direction. F. C. C.

2707. Coincidences Produced by Penetrating Radiation Bursts. H. Nie. *Zeits. f. Physik,* 99. 11–12. *pp.* 776–786, 1936.—The absorption of the radiation constituting bursts is examined with a coincidence arrangement of two ionisation chambers. The frequency of coincidences is determined for increasing thicknesses up to 5–6 cm. of Pb between the chambers. In many instances the burst in the lower chamber is greater than that in the upper. The general conclusion is that the bursts are produced by the passage of many particles originating from different centres and that the particles constituting the bursts have a mean range of 5 cm. of Pb and are probably electrons. F. C. C.

2708. Origin of Penetrating Radiation Bursts. H. Nie. *Zeits. f. Physik,* 99. 11–12. *pp.* 787–797, 1936.—Various relevant experimental evidence is reviewed and it is shown that the primary B-photons which give rise to bursts (*Stösse*) is absorbed in screens in exactly the same way as the shower-producing radiation. The relation between bursts and showers is discussed. F. C. C.

2709. Deviation of Charged Particles Passing through Magnetised Iron. W. F. G. Swann. *Phys. Rev.* 49. *pp.* 574–582, *April* 15, 1936.—In a piece of magnetised iron the magnetic entities which, on the Lorentz theory, are responsible for the polarisation, are considered as rotating electrically charged spheres. For electrons passing through the iron but failing to encounter any of these entities, the effective deflecting force is determined on the average by $h + 2\pi I$ (h = magnetic field intensity, I = intensity of magnetisation). The true average for all particles passing though is, however, the magnetic induction $B = h + 4\pi I$, but that average is contributed to in appreciable amounts by the relatively few electrons which pass through the entities and experience a deflection much in excess of that determined by B. [See following Abstract.] D. H. F.

2710. Deflection of Cosmic-Ray Charged Particles Passing through Magnetised Iron. W. E. Danforth and W. F. G. Swann. *Phys. Rev.* 49. *pp.* 582–591, *April* 15, 1936.—Experiments are described in which the deflection of cosmic ray particles in passing through magnetised iron is studied. Using known figures for the energy distribution of these particles, limits for the magnetic vector in the iron are derived. One experiment indicates these limits as B and B/2, another that they are B/4 and 3B/4. Theoretically, electrons of the same energy will not necessarily undergo the same deflection [see preceding Abstract], but will show a statistical distribution of deflections with an arithmetic average corresponding to the induction B. The type of experiment described does not give an arithmetic average, but would be expected to indicate for the effective deflecting vector a value which is less than B by an amount depending on the geometrical arrangement of the Geiger-Müller counters used. D. H. F.

2711. Range of One Shower Particle Produced by Cosmic Rays in Lead, Iron, and Aluminium. J. Clay. *Physica,* 3. *pp.* 352–358, *May,* 1936. *In English.*—An absorbing layer of varying thickness was placed in such a way that only one particle of a shower produced in a metal sheet could pass through it. Thus the absorption of one shower particle was measured in Pb, Fe and Al. The results show that the particles have a definite range. For lead showers the range in lead is 4·4 cm., which means an energy of about 87×10^6 eV. In iron the range of the lead showers was 5·6 cm. an increase in the same proportion as the density-decrease. The shower particles from iron had a range of 5·2 cm. in lead, larger than that of the lead shower particles. The ranges of shower particles from Al and air are again longer than those from Fe. AUTHOR.

See also Abstract 2670.

RADIATION, GENERAL THEORY.

See Abstracts 2877, 2903.

REFLECTION. REFRACTION AND DISPERSION.

2712. Reflecting Power of Iron as a Function of Temperature. L. S. Ornstein and J. H. van der Veen. *Physica,* 3. *pp.* 289–300, *May,* 1936. *In English.*—Measurements are made of the total reflecting power of iron as a function of temperature near the Curie point (1030–1050° K). The total reflecting power is measured for a wave-length of 6500 Å and an angle of incidence of $\sim$ 15°. Temperature is varied between $\sim$ 900 and 1200° K. The curves show that the reflecting power increases rapidly from $\sim$ 62 to 66 % when temperature is raised from 1000 to 1100°K. AUTHOR.

2713. Characteristic Function of Hamilton, the Eiconal of Bruns, and their Use in Optics. M. Herzberger. *Kodak Research Lab., Comm. No.* 583. *J.O.S.A.* 26. *pp.* 177–180, *April,* 1936.—In earlier work [see Abstract 4236 (1935)] from the law of Snellius a certain differential invariant was derived. In the present work are given the laws obtained by integrating this differential law. Four types of characteristic functions are found which, according to Hamilton, determine all the qualities of an optical system. A. H.

2714. Optical Image Formation. M. Herzberger. *J.O.S.A.* 26. *pp.* 197–204, *May,* 1936.—A report including the generalisation of Gaussian theory of image formation with regard to an arbitrary ray; the location of points with a sharp image, and points whose image caustics are symmetrical; the derivation of the angle eiconal *W* for systems with certain special qualities; and a discussion of the qualities of ideal optical systems. AUTHOR.

2715. Diminution of Refraction in Electrolyte Solutions. T. Neugebauer. *Zeits. f. Physik,* 99. 9–10. *pp.* 677–688, 1936.—The change in refractivity of an ion on account of the influence of neighbouring ions is calculated. With the help of simplifications, an expression is obtained which shows that the change of refractivity in electrolyte solutions cannot possibly be a Debye effect, but that it arises from true association. For the case of the alkali halides crystallising in the NaCl type, a formula is deduced to relate the degree of association with the change of refractivity on passing from the lattice to solution. If differences in nuclear separation between crystal and solution, and the effect of hydration, are neglected, the degree of association can be calculated. C. B. A.

2716. Temperature Dependence of the Molecular Refractions of CO_2 and of Acetic Acid vapour. H. Goldschmidt and P. Hölemann. *Zeits. f. phys. Chem.* 32. *Abt.B.* 5. *pp.* 341–352, 1936.—The variation with temperature of the refractivities (at 5461 Å) of CO_2 between 15° and 800° C. and of acetic acid vapour from 120° to 300° is measured. Up to 400° that of CO_2 is constant to 0·1 %, but between 400° and 800° it increases by 0·6 %, on account of excitation of higher vibration states in the molecule. The refractivity of acetic acid vapour decreases with rising temperature, on account of progressive dissociation of double molecules. The increase in refractivity of acetic acid due to association is about 1·5 %. It is suggested that the electron frequency controlling the refractivity is diminished and that the probability of the electron transition is increased by the effect of association. C. B. A.

2717. Change of Refraction and Dispersion in the Transition from Vapour to Liquid States. P. Hölemann. *Zeits. f. phys. Chem.* 32. *Abt.B.* 5. *pp.* 353–368, 1936.—Molecular refractions at three visual wave-lengths are determined for liquid $SiCl_4$, $SnCl_4$ and $SnBr_4$, and the results compared with those obtained for the vapours. Similar data for a range of other compounds are also collected. With some exceptions, liquefaction is associated with a definite decrease in refraction which is not related to the magnitudes of the dipole moments. The characteristic frequency as deduced from a dispersion equation also changes with state of aggregation. In H_2O, part of the effect is due to a change in the contribution to the refraction from the infra-red bands. The effect can best be explained by the simultaneous effects in the liquid of association (producing an increase) and the internal field (producing decrease). The latter usually predominates. C. B. A.

2718. Intensity of Illumination in Standing Lenses with Large Aperture. E. Noteboom. *Zeits. f. Instrumentenk.* 56. *pp.* 188–194, *May*, 1936.—The remarkable increase in illumination of an object which often occurs when this is viewed through a plano-convex standing lens is explained by artificial exclusion of side light or predominance of direct light. The unavoidable shading of the latter by the head of the observer has less effect with standing lenses than with other lens types. C. B. A.

2719. Lens Series. H. Schulz. *Zeits. f. Instrumentenk.* 56. *pp.* 194–196, *May*, 1936.—An investigation of the correction of lens series. C. B. A.

See also Abstracts **2577, 2581, 2669, 2674, 2681, 2699.**

SPECTROSCOPY.

2720. Excitation of Hydrogen Lines H_α, H_β and H_γ by Ultra-Short Electric Waves. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 1–3, *Jan.*, 1936. *In English.*—An electrodeless tube containing H_2 at a pressure of 0·01 mm. is excited by means of 0·2 m. waves. Using a Fabry-Perot interferometer the structure of H_α is more distinct at room-temperature than with a Geissler tube immersed in liquid air and excited by a high-tension transformer. The only drawback of this method of excitation is the long exposure necessitated by the small output. The line structures are still more clearly marked when the H_2 is present in minute quantities as an impurity in He. This is undoubtedly due to the extremely low partial pressure of H_2 in the He mixture. A. H.

***2721. Vacuum Spectroscopy. H. Bomke.** *Phys. Zeits.* 37. *pp.* 222–260, *April* 1, 1936.—This report comprises a survey of the principal advances in vacuum spectroscopy which have been made since the publication in 1928 by Lyman of the monograph : "The Spectroscopy of the Extreme Ultra-Violet." The scope of the report is evidenced by the following headings and sub-headings under which the material is classified : atomic spectra ; molecular spectra ; wave-length standards in the extreme ultra-violet ; investigations of absorption of solid bodies ; photo-effect in the vacuum ultra-violet ; *b*-spectra (optical spectra from excitation of inner electrons) ; ultra-soft X-rays ; fluorspar spectrographs ; grating spectrographs (*a*) with perpendicular incidence (*b*) with glancing incidence ; light-sources (vacuum spark, hollow kathode, electrodeless discharge, continuous light sources, etc.) ; photographic plates for the short-wave ultra-violet. A list of 251 references to the literature on this subject is appended. J. E. K.

2722. Absorption Spectrum of Hydrogen. Part III. Auto-Ionisation in the $3p\pi\ {}^1\Pi_u$ Term of H_2 and its Selection Rules. H. Beutler and H. O. Jünger. *Zeits. f. Physik*, 100. 1–2. *pp.* 80–94, 1936.—Diffuse R- and P- lines commence at about 805 Å in the absorption spectrum of H_2. In the vibration state $v' = 6$ of the $3p\pi\ {}^1\Pi_u$ terms, the rotation levels $K'_d = 1$ and 2 are sharp, whilst $K'_d = 3$, 4 and 5 are diffuse. The rotation terms K'_c (of the Q-lines) are all sharp. This cannot be explained by assuming predissociation ; but an auto-ionisation process, $H_2^* \rightarrow H_2^+ + e$, would diminish the life of the excited terms and give rise to their diffuseness. It is shown that the following selection rules hold for this decomposition : $\Delta K_d = \pm 1$; $\Delta K_c = 0$; and the $3p\pi$ electron is split off as odd electron (referred to H_2^+). In the auto-ionisation, a para- or ortho- H_2^* molecule always gives a para- or ortho- H_2^+ ion respectively. The ionisation energy is 124429 cm^{-1}, as compared with 124569 cm.$^{-1}$ obtained by Richardson and Davidson by extrapolation. [For Part II, see Abstract 707 (1936).] C. B. A.

2723. Intensity Distribution in the Diffuse Series of Potassium. P. A. Coenen and H. A. Kramers. *Physica*, 3. *pp.* 341–345, *May*, 1936. *In German.*—Quantum mechanical calculation of the intensities in the diffuse series of K gives excellent agreement with the experimental values obtained by van der Held and Heierman. In particular, the extraordinary weakness of the second line is explained. C. B. A.

2724. Heisenberg's Oscillator Model and Nuclear Moments. P. Pavinskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 4. *pp.* 169–171, 1936. *In English.*—Heisenberg's modification of the theory of the packing fractions of nuclei, used in conjunction with the Landé scheme, is applied to nuclei with an odd number of protons, and results for the mechanical and magnetic moments, tabulated for 20 elements, are in good agreement with experimental data. N. M. B.

2725. Theory of Pressure Broadening of Spectral Lines. E. Gora. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 272–284, *March*, 1936.—Asymmetric broadening and shift of spectral lines under foreign gas pressure are ascribed to perturbations of the energy levels of the excited atoms, due partially to their coupling with the same set of virtual oscillations of the foreign gas, which determines its dispersion. A general treatment of these dispersion forces is given which yields a simple relation between the refractive index of the perturbing gas and the red shift produced by these interactions. The width and violet shift are possibly due to coupling interactions of a more general type which would depend to some extent upon the alteration of the relative positions of perturbing and radiating atoms. A. H.

2726. Pressure Effects in Band Spectra. H. Margenau. *Phys. Rev.* 49. *pp.* 596–597, *April* 15, 1936.—A simple theory is presented describing pressure effects on band lines, in so far as they are due to foreign perturbing molecules without permanent polarity. Results are: Band lines are shifted and broadened much in the manner of atomic lines as a result of van der Waals interactions. Calculations with the models of a rigid rotator and a simple harmonic oscillator, for which formulæ are given, show that the effects are practically independent of rotational and vibrational quantum numbers. AUTHOR.

2727. Numerical Tables for the Rapid Calculation of Polarisation in Optical Resonance. P. Soleillet. *J. de Physique et le Radium,* 7. *pp.* 173–180, *April,* 1936.—Tables are given which can be used for evaluating the quantities involved in the equations previously given [see Abstract 2207 (1936)]. These equations are modified in the present paper, so as to be more amenable to numerical evaluation. A. C. M.

2728. Wave Functions for $1s2s\ ^1S$ Helium. A. S. Coolidge and H. M. James. *Phys. Rev.* 49. *pp.* 676–687, *May* 1, 1936.—The $1s2s\ ^1S$ state of He is treated with a variant of Hylleraas' variational method, and a wave function is determined which gives an error of only 0·005 eV in the energy of the system. The properties of desirable functions for use in this method are discussed. Wave functions of the Hartree and Fock types, and a more flexible function not involving r_{12}, are also determined by simple variational processes. The properties of the resulting functions are compared, and are discussed in the light of the polarisation method of Hylleraas and Bethe, properly applicable to more highly excited states. The computations by the polarisation method are extended, and the results are compared with those given by the variational procedure. [See following Abstract.] AUTHORS.

2729. Ground State of Lithium. H. M. James and A. S. Coolidge. *Phys. Rev.* 49. *pp.* 688–695, *May* 1, 1936.—Wave functions of several forms are applied to the treatment to the ground state of Li. It is found that errors in the representation of the K shell have but little effect on the computed ionisation energy, and that a satisfactory orbital for the L electron can be constructed in a very simple form. The best wave function in which the relative positions of the K and L electrons are not taken into account gives an ionisation energy in error by 0·05 eV. To take account of inter-shell polarisation effects the Hylleraas method is extended, and a wave function is constructed which depends on the relative positions of all the electrons. A total energy in error by 0·068 eV (0·034 %) is computed, and the theoretical value of the ionisation energy is fixed as 5·363 ± 0·007 eV against an observed 5·364 eV. [See preceding Abstract.] AUTHORS.

2730. Band Spectra of Tellurium Halides and the Isotope Effect in Electron Spectra of Polyatomic Molecules. M. Wehrli. *Helv. Phys. Acta,* 9. 3. *pp.* 208–233, 1936. *In German.*—The discrete absorption spectra of $TeCl_2$ and $TeBr_2$ between 6500 and 4700 Å are investigated. Both are diffuse, and as a continuum is superposed, and they do not appear in either emission or fluorescence, predissociation must occur. In the spectrum of TeI_2 vapour, the iodine spectra can be recognised. Despite the diffuseness, an end isotope effect of chlorine is established in

$TeCl_2$. Rules for the isotope separations in electronic band spectra of polyatomic molecules are deduced. In linear, triatomic, symmetrical molecules, a direct experimental determination of the isotopy factor f of the various vibrations is possible. In $TeCl_2$, the experimental values for f are 0·0144 and 0·0090 as compared with theoretical values of 0·0139 and 0·00903 respectively. The $TeCl_2$ molecule in the ground state and in excited states is linear or approximately so. C. B. A.

2731. Fluctuation Bands of Tellurium Vapour. M. Désirant and A. Minne. *Comptes Rendus*, 202. *pp*. 1272–1273, *April* 6, 1936.—The fluctuation bands of Te are investigated under high dispersion and consist of two series of bands. The interpretation of the bands is the same as for the corresponding bands of Se. W. R. A.

2732. Band Spectra of Alkaline-Earth Hydrides. B. Grundström. *Zeits. f. Physik*, 99. 9–10. *pp*. 595–606, 1936.—A new band-system of BaH corresponding to the $\mathrm{c}^2\Sigma \rightarrow \mathrm{x}^2\Sigma$ of CaH and SrH at λ3533 and λ3808 respectively is obtained in absorption with Ba in H_2 at about 60 cm. pressure in a furnace at 1400–1500° C., and photographed in dispersions of about 10 and 5 Å/mm. The bands identified have P heads near λλ4228 (0,0), 4201 (1,1), 4014 (1,0), 3999 (2,1) and 3986 (3,2). The 1,1 band is obtained feebly in emission also. The rotational analysis of the 1,0 and 2,1 bands is given, and the other bands are described briefly. For the $\mathrm{c}^2\Sigma$ state the values of B and -10^4D are 3·48 and 0·25 for $v = 1$ and 3·44 and 1·1 for $v = 2$. The 0,0 band shows extraordinarily large perturbations like those in the $\mathrm{c} \rightarrow \mathrm{x}$ systems of CaD and SrH; the perturbations in the 1,0 and 2,1 bands of BaH are very small. Line-broadenings in absorption and a break-off in the 1,1 band in emission indicate that predissociation of the $\mathrm{c}^2\Sigma$ state of BaH occurs at $v = 1$, $K = 8$. Particulars of the electronic states of MgH, CaH, SrH and BaH are collected and compared in tables and diagrams. W. J.

2733. Induced Predissociation in S_2 Absorption Bands. V. Kondratjew and E. Olsson. *Zeits. f. Physik*, 99. 9–10. *pp*. 671–676, 1936.—In an investigation of the absorption spectrum of S_2 vapour with an added foreign gas (N_2), an induced predissociation is found in the u.v. S_2 bands $\mathrm{B}^3\Sigma \leftarrow \mathrm{X}^3\Sigma$. It is most marked near $v' = 9$ (in Naudé and Christy's v' numbering which is used throughout the paper without the required correction of $+1$), *i.e.*, immediately below the first ordinary predissociation point. The dissociation energy of S_2 is discussed in connection with these new observations, and given as $\leqq 4 \cdot 1$ V. for the ground state. W. J.

2734. Absorption Spectra of Dipheneins. H. W. Underwood, Jr., L. Harris and G. Barker. *Am. Chem. Soc., J.* 58. *pp*. 643–645, *April*, 1936.—The absorption spectra of neutral and alkaline solutions of phenoldiphenein and several of its derivatives are obtained. Absorption bands characteristic of the dipheneins are noted. In both neutral and alkaline solutions the absorption spectra of the dipheneins are quite different from the phthaleins. All the diphenein derivatives tested show essentially the same absorption spectra in alkaline solution. AUTHORS.

2735. Temperature Change in Absorption Spectrum of Cobalt Chloride in HCl Solution. O. R. Howell and A. Jackson. *Roy. Soc., Proc.* 155*A*. *pp*. 33–41, *May* 18, 1936.—The absorption spectra of four solutions containing 12 gm. of $CoCl_2 6H_2O$ per l. in 4·0, 6·0, 6·5 and 8·5 N HCl, respectively, are measured at a series of temperatures. The extinction coefficients at the maxima of the two principal bands, 695 $m\mu$ and

666 $u\mu$, are plotted against the temperature. For any given concentration of HCl, the extent of the transformation from red to blue, even over a wide range of temperature, is small compared with the total change previously investigated by increasing the concentration of HCl at constant temperature. The four curves together cover the whole range of the transformation and they are fully explained in terms of the theory previously advanced. The extinction coefficients at the maxima of the two auxiliary bands, 626 $m\mu$ and 610 $m\mu$, are plotted against the temperature for the 8·5 *N* HCl in which the transformation reaches completion. It has previously been shown [see Abstract 5337 (1933)] that with increasing concentration of HCl at constant temperature, the curves for these two bands continue to rise beyond the concentration at which those for the two principal bands have reached constancy, and this is attributed to the effect of depression of ionisation on the two auxiliary valences. With a given concentration of acid the curves for the two auxiliary bands reach constancy at the same temperature as those for the two principal bands, since the degree of ionisation is not greatly affected by change of temperature.
AUTHORS.

2736. Emission Spectrum of Bismuth Fluoride (BiF). H. G. Howell. *Roy. Soc., Proc.* 155*A*. *pp*. 141–150, *May* 18, 1936.—A band spectrum attributed to BiF is excited by means of a h.f. discharge in the vapour of BiF_3. The bands stretch from 4150 to 5100 Å and are all degraded to the red. A vibrational analysis is made, all the bands belonging to one system A → X with the following constants :—

Level	ν_e	ω_e	$x_e\omega_e$	$y_e\omega_e$
A	22959·7	381·0	3·00	0·10
X	0·0	510·7	2·05	—

The intensities of the bands follow a narrow Condon parabola. The dissociation products could not be identified with certainty, although if the lower level dissociates into normal atoms it is probable that the upper state dissociates into a normal F, and an excited Bi ($^2D_{3/2}$) atom. The vibrational constants are shown to be nearly equal to those of PbF. A short discussion of this similarity is given.
AUTHOR.

2737. λ2530 Band of NH. R. W. Lunt, R. W. B. Pearse and E. C. W. Smith. *Roy. Soc., Proc.* 155*A*. *pp*. 173–182, *May* 18, 1936.—The λ2530 band of NH is excited by a hollow kathode discharge in streaming NH_3 with sufficient intensity to photograph under high dispersion. The band corresponds to a $^1\Sigma^+ \rightarrow {}^1\Pi$ transition and the $^1\Pi$ state is shown to be identical with that already known from the λ3240 band ($^1\Pi \rightarrow {}^1\Delta$) and the λ4502 band ($^1\Pi \rightarrow {}^1\Sigma^+$). Rotational constants calculated for the $d^1\Sigma^+$ state are $B_0 = 14{\cdot}09$ cm.$^{-1}$, $D_0 = -1{\cdot}60 \times 10^{-3}$ cm.$^{-1}$, $r_0 = 1{\cdot}125 \times 10^{-8}$ cm. A table is given showing the values of the rotational constants of the six electronic states now known for the molecule NH. [See also Abstract 4275 (1935).]
AUTHORS.

2738. Validity of Franck-Condon Principle in Determinations of Intensity Distribution in Molecular Spectra. W. Finkelnburg. *Zeits. f. Physik*, 99. 11–12. *pp*. 798–800, 1936.—The Franck-Condon principle only gives a satisfactory approximation for heavy molecules vibrating with small change in nuclear separation, and not when larger nuclear displacements occur. In such cases the variation with nuclear separation of that part of the transition probability which arises from movement of electrons must be taken into account.
C. B. A.

2739. Spectroscopy and Valency. Part IV. Periodic Groups of Hydride Di-Atoms. C. H. D. Clark. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 218–220, *April*, 1936.—The classification of hydride di-atoms into periodic groups is devised according to electron configuration, enabling gradations of spectroscopic and related constants to be traced in periods and groups, and assisting the prediction of numbers not yet experimentally determined. It is improbable that the normal ground state spin of a diatomic hydride can exceed one quantum unit. [See Abstract 1659 (1935) and following Abstract.] AUTHOR.

2740. Spectroscopy and Valency. Part V. Periodic Functions of Hydride Di-Atoms. C. H. D. Clark and J. L. Stoves. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 221–230, *April*, 1936.—The spectroscopic and bond-constants of hydride di-atoms as periodic group functions are considered, with graphical representation. The curves are of a characteristic type which show no maxima corresponding to those found in the case of non-hydride di-atoms. It is found that the hydrides of atoms having a shell of 18 electrons underlying the outermost valency group give curves of a characteristic type which is entirely different from that of hydrides of atoms yielding ions of inert gas-like structure. The results enable a number of predictions concerning the spectroscopic constants of hydride di-atoms to be made. [See preceding Abstract.] AUTHORS.

2741. Isotope Displacement Effect in the Band Spectrum Deuterides of Mercury. S. Mrozowski. *Zeits. f. Physik*, 99. 3–4. *pp.* 236–251, 1936.—The author has previously investigated the complex structure of the bands in the HgD spectrum. In full analogy with the results of earlier investigations on the structure of the HgH band spectrum, it is seen that each band-line in the ^{2}H → $^2\Sigma$ band system is four-fold and that the four components must be ascribed to the four even-numbered Hg isotopes. The results of the investigations on the isotope-displacement effect in HgH and the HgD spectrum are summarised and an explanation of their behaviour is proposed which exhibits a modification of Bohr's original explanation. At the same time the questions of the possibility of the observation of the isotope-displacement effect and of the splittings of the hyperfine structure in band spectra in general are discussed. J. J. S.

2742. Λ-Type Doubling in $^3\Pi$ States of Diatomic Molecules Intermediate between Hund's Cases a and b. M. H. Hebb. *Phys. Rev.* 49. *pp.* 610–618, *April* 15, 1936.—Theoretical formulas are developed for Λ-type doubling in $^3\Pi$ states with coupling intermediate between Hund's cases *a* and *b*. Previously only the limiting cases *a* and *b* had been considered for triplet states. It is shown that, in addition to the usual splitting caused by the Π–Σ interaction, there is a contribution to the doubling of the $^3\Pi_0$ component arising from the magnetic spin—spin coupling between individual electrons. The expressions for the doubling necessitate the numerical solution of a cubic equation for each value of J but are otherwise simple and easy of application. Comparison with experiment is made for N_2 where good agreement is found. Fine structure of $^3\Sigma$ states, ρ-type tripling, is also considered. It is shown that this fine structure can arise from perturbation by Π states—a " reflection " of the Λ-type doubling in these states. [See following Abstract.] A. H.

2743. Theory of Band Spectra of PH and NH. C. Gilbert. *Phys. Rev.* 49. *pp.* 619–624, *April* 15, 1936.—The theoretical formulæ for the effect of molecular rotation on spin multiplets are considered for triplet cases. The form of the "swelling" term in D is found for the limiting case *a*, and its importance is evident in the explanation of the experimental observations on PH and NH. Formulæ are given, from which the molecular constants A, B and D can be calculated. This is done for the two examples mentioned, moreover for PH the Λ-type doubling is calculated from the theoretical formulæ derived by Hebb [see preceding Abstract], and is found to agree well with experiment. The explanation of the observations on NH necessitated considering an appreciable ρ-type tripling in the $^3\Sigma$ level, which has not been observed before. AUTHOR.

2744. Wave-Mechanical Treatment of the LiH Molecule. J. K. Knipp. *J. Chem. Phys.* 4. *pp.* 300–307, *May*, 1936.—The two inner shell electrons of the Li atom are represented by Slater wave functions, elliptical coordinates being used for the outer electron wave functions which take the form of an exponential times a power series. Calculations are also made for the LiH^+ ion, the lowest state being a $^2\Sigma$ state, the dissociation products normal H and ionised Li; it is the only one-quantum state. The use of a flexible eleven-term function gives at an internuclear distance of three Bohr radii an energy of repulsion of 0·181 eV. The lowest state of the ion is stable with an equilibrium distance greater than three Bohr radii. The energies of the four two-quantum $^2\Sigma$ states of LiH^+ at the same internuclear distance are obtained from the next four roots of the eleventh-order equation already used. These states are found to be strongly repulsive. An eight-term wave function is tried for the $^3\Sigma$ state of LiH dissociating to the same products as the ground state. There is a repulsion of 1·89 eV at the equilibrium distance. A. H.

2745. Vibration-Rotation Energy Levels of Polyatomic Molecules. Part I. Mathematical Theory of Semi-Rigid Asymmetrical Top Molecules. E. B. Wilson, Jr., and J. B. Howard. *J. Chem. Phys.* 4. *pp.* 260–268, *April*, 1936.—From the exact classical kinetic energy for a system of point masses the correct form for the quantum-mechanical Hamiltonian operator is derived. In order to secure better approximations than for a rigid top, and with larger amplitudes of vibration, a perturbation method is introduced which permits the change of moment of inertia with vibration, the coupling of rotation and vibration, and the centrifugal stretching effects to be taken into account. If the stretching terms alone are neglected, the secular equation for the rotational energy levels can be reduced to the Wang form, except that "effective moments of inertia" must be used whose magnitude depends on the vibrational quantum state. For molecules of less than orthorhombic symmetry the orientation of the principal axes of inertia may vary with the vibrational quantum number. A method is indicated for calculating the terms for large centrifugal effects. [See following Abstract.] N. M. B.

2746. Vibration-Rotation Energy Levels of Polyatomic Molecules. Part II. Perturbations Due to Nearby Vibrational States. E. B. Wilson, Jr. *J. Chem. Phys.* 4. *pp.* 313–316, *May*, 1936.—The use of the Wang secular equation for the interpretation of the rotational structure of a vibration-rotation band of an asymmetrical top molecule is not justified if either of the vibrational states involved in producing the band is perturbed by another vibrational state of nearly the same energy. The present paper discusses the conditions under which such a perturbation is to be expected and gives the secular equation which should be used instead of the Wang determinant in case the perturbation is important.

This equation assumes a somewhat simpler form when applied to orthorhombic molecules, in which case it involves only one parameter in addition to the three moments of inertia. [See preceding Abstract]. AUTHOR.

2747. Molecular Constants and Potential Energy Curves for Diatomic Molecules. Part II. M. L. Huggins. *J. Chem. Phys.* 4. *pp.* 308–312, *May*, 1936.—The potential energy expression $U = e^{-a(r-r_{12})} - C'e^{-a'(r-r_e)}$ previously applied to diatomic molecules containing only first row elements is now applied to other types. For most of them the same value of a ($6\cdot0 \times 10^8$ cm.$^{-1}$) can be used satisfactorily, the r_{12} values then being additive and depending only on the row of the periodic table in which the atoms occur. Molecules containing but few electrons require different values of a and r_{12}. Values of the equilibrium distance r_e, calculated from ω_e, $\omega_e x_e$ and these constants, are in most cases within 0·02 or 0·03 Å of the experimentally determined distances. The relation between Badger's empirical equation for the calculation of r_e and the equations used in this paper is discussed. [For Part I, see Abstract 3891 (1935).] AUTHOR.

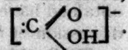
2748. Characteristic Vibrations of Mechanical Molecular Models. Part III. Plane 6-Ring and its Derivatives. F. Trenkler. *Phys. Zeits.* 37. *pp.* 338–345, *May* 1, 1936.—Using the same type of mechanical model and excitation [see Abstract 3522 (1935)], characteristic frequencies and modes of vibration are investigated for plane models of unsaturated 6-ring molecules (cyclohexene, cyclohexadiene and cyclohexatriene). The investigations are also extended to benzene, using a model having all the ring bonds of equal strength, and to the mono- di- and tri- substituted derivatives of benzene. The observed results show both qualitative and quantitative agreement with theory. With increasing numbers of masses, however, they become incomplete and uncertain, this probably being due to the inadequacy of the mechanical excitation of the larger models with much branching. The data here obtained have been utilised by Kohlrausch [see Abstract 1711 (1936)] in a discussion of the vibration spectra of benzene derivatives. L. A. W.

2749. Absorption Spectra of HCl and HBr and Their Upper Unstable States. H. Trivedi. *Nat. Acad. Sci., India, Proc.* 6. *pp.* 18–34, *Feb.*, 1936.—A photographic method is used to investigate the continuous absorption spectra of HCl and HBr at different temperatures. The contributions of individual vibrational levels to the total absorption are found. With the help of the theory worked out elsewhere and assuming the Kratzer function to be approximately correct for the potential energy of the lower state, the forms of the upper potential energy curves are calculated. It is found that the positions representing the dissociation of the molecules in their unstable states lay 103·9 and 92 k.cal. above the minimum of the lower states in the Franck-Condon diagrams, respectively, the same as the atomic heats of formation of the molecules determined thermochemically (101 and 86 k.cal.). [See Abstract 1691 (1936).] AUTHOR.

2750. Paschen-Back Effect. Part III. $^2S^2P$ Multiplets in Strong Fields. J. B. Green and R. A. Loring. *Phys. Rev.* 49. *pp.* 630–632, *April* 15, 1936.—The Paschen-Back effect of $^2S^2P$ multiplets is discussed and the theory verified in detail. In particular, the $^2S^2P$ multiplet of Li, λ6708, is resolved in reversal and shows the fine structure predicted but not heretofore observed. [See following Abstract.] AUTHORS.

2751. Paschen-Back Effect. Part IV. Mutual Spin-Orbit Interaction in Two-Electron Spectra. J. B. Green and R. A. Loring. *Phys. Rev.* 49. *pp.* 632–634, *April* 15, 1936.—The effect of a strong magnetic field on the Be triplet λλ3321, $^3P^3S$ is studied. The experimental patterns are compared with calculations which take account of the interaction between the spin of one electron and the orbit of the other. The experimental results are in excellent agreement with the theory, but in some disagreement with Back's earlier work on this group of lines. [See Abstract 5068 (1934) and preceding Abstract.] AUTHORS.

2752. Nature of Intermolecular Oscillations in Organic Crystals. S. C. Sirkar. *Indian Journ. Phys.* 10. *pp.* 99–116, *March*, 1936.—Raman spectra of naphthalene and of diphenyl ether are investigated in liquid and solid states and in solution. Differences which appear as the physical state is changed are attributed to polymerised groups of molecules which are more stable in the case of polar substances. Additional evidence in favour of this view is adduced from the examination of the absorption spectra. W. R. A.

2753. Raman Spectra of Formic Acid and Formates. J. Gupta. *Indian Journ. Phys.* 10. *pp.* 117–125, *March*, 1936.—The Raman spectra of formic acid (pure and in aqueous solution), and of the formates of Na, Ba, Cd in the crystalline state and in solution, and of a solution of sodium trichloracetate, are investigated. The 2963 cm.$^{-1}$ C-H oscillation in formic acid is split into two faint lines in the crystals of the salts, giving a broad line in the same place and a sharp line at 2874 cm^{-1}. When the crystals are dissolved, 2963 cm.$^{-1}$ disappears, and only a sharp line appears at about 2834 cm^{-1}. The line 1398 cm.$^{-1}$ in formic acid is also split in the solutions of the salts, while a weak line at 1650 cm.$^{-1}$ in the case of the latter appears in place of 1675 and 1724 cm.$^{-1}$ of formic acid. Similar alterations take place in the cases of a few other lines. An explanation is put forward, based on the hypothesis that when the metallic formates are dissolved, the H moves round to the O, so that the ion in solution is  $\left[:C\begin{matrix}\diagup O\\ \diagdown OH\end{matrix}\right]^-$. This hypothesis is supplemented by considering the characteristic frequencies of the carboxyl group in fatty acids, and the changes they undergo when converted into salts and salt solutions. By comparing the Raman spectra of trichloracetic acid and sodium trichloracetate solution the motion which gives rise to the 1353 cm.$^{-1}$ metal formate line is deduced. A. C. M.

2754. Raman Effect of Methylcyclopentane Derivatives. M. Godchot, Germaine Cauquil and R. Calas. *Comptes Rendus*, 202. *pp.* 1129–1130, *March* 30, 1936.—Raman spectra are reported for the following compounds: 1-methylcyclopentanone-3-*d* and the two alcohols, *cis* and *trans*, derived from it; 1-methylcyclopentanone-3-(*d* + *l*) and its two secondary alcohols, *cis* and *trans*. It is found that the principal lines considered to belong to the methylcyclcopentane group are present in all the substances. The spectra of the active compounds are identical with the corresponding racemic ones. The spectra of the *cis* alcohols do not differ markedly from those of the *trans* alcohols in the region 200 to 800 cm.$^{-1}$, while the acetic esters of the *cis* and *trans* alcohols have marked differences in their spectra. A. C. M.

2755. Polarisation of Raman Bands of Water and Deuterium Oxide. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 201–205, *March*, 1936.—The Raman spectra of liquid H_2O and D_2O are photographed by interposing a double image prism in front of the slit of the spectrograph. The three components of the principal Raman band in the two cases are more and more depolarised in the order of increasing frequency, the component of lowest frequency being highly polarised, and that of highest frequency being highly depolarised. The band $\Delta\nu = 1235$ cm.$^{-1}$ in the case of D_2O is imperfectly polarised, while the low frequency Raman band ($\Delta\nu \approx 175$ cm.$^{-1}$) is depolarised to the extent of 6/7 in both cases. A tentative explanation is suggested to interpret the observed results. [See Abstract 5054 (1935).] AUTHOR.

2756. Raman Spectra of Deuterium-Substituted Acetic Acids. W. R. Angus, A. H. Leckie and C. L. Wilson. *Roy. Soc., Proc.* 155*A*. *pp*. 183–194, *May* 18, 1936.—The Raman spectra of $(CH_3CO)_2O$, CH_3CO_2H, CH_3CO_2D, and CD_3CO_2D are investigated. The three acetic acids give similar spectra, the lines of which are divisible into three classes (*a*) unmodified lines, (*b*) lines modified in CD_3CO_2D only, and (*c*) lines showing progressive modification with D-content. This classification of the lines is of great assistance in establishing their origin in the molecule. Without knowledge of the symmetry class, however, only a qualitative assignment of the frequencies is possible. This has been made. The frequencies assignable to the CH_3 group are unmodified in CH_3CO_2D indicating that only the carboxylic protium has been replaced by deuterium. The frequency corresponding with the symmetrical C-D vibration is 2111 cm.$^{-1}$ and that corresponding to the CD_2 group is 1100 cm.$^{-1}$. [See Abstract 3070 (1935).] AUTHORS.

2757. Raman Effect and Free Rotation. K. W. F. Kohlrausch and G. P. Ypsilanti. *Zeits. f. phys. Chem.* 32. *Abt.B.* 5. *pp*. 407–416, 1936.—Fifteen compounds of the type $X.CH_2.CH_2.CH_2.Y$, comprising 3 distinct groups with respect to one of the substituent groups, are investigated. The data are so complicated that it is impossible to draw definite conclusions. W. R. A.

2758. Spectroscopic Investigation of Molecular Association. M. W. Wolkenstein. *Acta Physicochimica*, 4. 3. *pp*. 357–364, 1936. *In German*.—The selection rules for the infra-red and Raman spectra of molecules, and the polarisation states in the Raman effect allow a determination of the symmetry of the molecule. In this paper the author discusses how far conclusions of this kind are affected by molecular association. Two types are considered; in the first, weak association forces are postulated, corresponding to energies of not more than 10 k.cal./mol., and then it is concluded that the molecules can be considered as still unassociated, but with the original symmetry upset. In the second type, association forces are postulated approaching in magnitude chemical binding forces. The energy of the association is regarded as less than that appropriate to homopolar or heteropolar binding, but much greater than that of solvation. The product of such an association is intermediate between a true chemical compound and a van der Waals complex. The frequency 622 cm.$^{-1}$ which occurs in the Raman spectrum of solutions of acetic acid, and is greatly weakened by dilution, is regarded as due to an association of two acetic acid molecules. Other cases are considered. A. C. M.

***2759. Spectrometer for Studies at High Pressures. W. J. Lyons and F. E. Poindexter.** *J.O.S.A.* 26. *pp*. 146–148, *April*, 1936.—A spectrometer designed specifically for the study of liquids under high pressure is described in detail. The liquid prism is confined between elliptical plate glass windows 6 mm. thick fastened into the ends of a short rubber sack, the whole being encased in a cylinder of thick walls through which narrow horizontal slits are cut. It is found that the most accurate method for determining the angle A of the liquid prism is to fill the sack with distilled water at a known temperature and then determine the angles of minimum deviation for the three or four most prominent Hg arc lines at atmospheric pressure. Knowing the refractive indices of water for these lines A is easily obtainable. A. H.

2760. Enhancement of Radiation in Singing Arcs. T. Peczalski. *Comptes Rendus*, 202. *pp*. 1040–1042, *March* 23, 1936.—The spectra of NaCl and $CaCl_2$ in the silent and singing arcs are compared and discussed. W. R. A.

2761. Spectroscopic Investigation of Discharges at High Gas Pressure. W. W. Watson and G. F. Hull, Jr. *Phys. Rev.* 49. *pp*. 592–596, *April* 15, 1936.—Spectra of high energy capacity discharges between electrodes of various metals in N_2, H_2, O_2 and He at pressures up to 15 atmospheres are examined at high dispersion. With the ever-present continuous spectrum as a background, absorption bands due to AlH, MgH, BeO, etc., are observed. The lines of the (0,0) $^1\Pi \rightarrow {}^1\Sigma$ AlH band at 4260 Å which are not affected by predissociation ($J < 22$) are all uniformly shifted to the red (0·05 cm.$^{-1}$ per atmos.) and symmetrically broadened (half-width 0·24 cm.$^{-1}$ per atmos.) by about the same amount as for the pressure effect of H_2 on S-P resonance lines. $\Sigma \rightarrow \Sigma$ bands (CN, BeO) exhibit but slight pressure effects; BeO $^1\Sigma \rightarrow {}^1\Sigma$ band lines are shifted 0·033 cm.$^{-1}$ to the red per atmos. of O_2, with no dependence on K. Details of the pressure broadening of the Al resonance lines are presented. The breadths and shifts of the emission lines are attributed principally to interatomic Stark effect plus slight resonance broadening, while the contours and pressure shifts of the self-reversals are about those expected if due to van der Waals forces between Al atoms and gas molecules. AUTHORS.

2762. Selective Effect of H.F. Fields on Flames. A. E. Malinowski. *Phys. Zeits. d. Sowjetunion*, 9. 2-3. *pp*. 264–267, 1936. *In German.*—The possibility of observing a selective effect of h.f. fields on flames is investigated. The eigenfrequency of an " electron plasma " in a flame is calculated and is compared with the frequency of the field at which an increase in flame velocity is observed to set in. The order of magnitude is the same in each case. [See also following Abstract.] C. B. A.

2763. Influence of Electric Fields on the Absorption Spectrum of the C_2H_2 Flame. A. E. Malinowski and W. S. Rossichin. *Phys. Zeits. d. Sowjetunion*, 9. 2–3. *pp*. 268–270, 1936. *In German.*—In an electric field, some absorption lines and a short wave-length continuum disappear from the spectrum. This is in accordance with the theory that the active centres associated with charged particles in the flame are removed by the field. [See preceding Abstract.] C. B. A.

See also Abstracts 2484, 2670, 2820, 2821.

X-RAYS.

***2764. Electron Distribution in the Focus of an X-Ray Tube. J. Dosse.** *Zeits. f. techn. Physik.* 17. 4. *pp*. 121–125, 1936.—The apparatus consists essentially of an X-ray tube the anode of which is perforated to permit electrons to pass through it into a Faraday cylinder which permits the electron-distribution to be found. After passing through the anode the electrons enter an "electron lens" which gives, in effect an enlarged image of the array of perforations and so facilitates the measurements. The filament is of the spiral form, and it is found that the electrons tended to form two concentric rings on the anode. The definition of the rings depends on the current through the tube, the tube voltage, and whether the filament is heated by direct or alternating voltages. At the higher voltages and currents and also with a.c. heating the definition of the rings becomes lower, and the focal spot consequently more uniform. G. E. B.

2765. Scattering of X-Rays from Amorphous Substances and Their Molecular Distributions. M. Ogura. *Tôhoku Univ., Sci. Reports*, 24. *pp.* 587–594, *Feb.*, 1936. *In English.*—It is shown that Debye-Menke's method [see Abstract 517 (1931)] which gives molecular distributions in amorphous substances from measurements of scattered X-rays, is also applicable to polyatomic substances, if the intensities of both unmodified and modified scattering are taken into account. AUTHOR.

2766. Atomic Scattering Factor of Cadmium for CuKα Radiation. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.*, 3. *pp.* 200–207, *April*, 1936.—Measurements are made of the intensities of reflection of CuKα radiation from finely divided Cd powder and values of the atomic scattering factor of the Cd atom in metallic Cd at room-temperature are obtained. These measurements are placed on an absolute scale by comparing reflections from Cd with reflections from Al powder. It is shown that the irregularities in the scattering factor of Cd when plotted against $(\sin\theta)/\lambda$ are exactly similar to those found with Zn, which indicates that in Cd, as in Zn, the atoms have a greater mean amplitude of vibration normal to the basal plane, *i.e.*, parallel to the c-axis, than in the basal plane. AUTHOR.

2767. Absorption of Soft X-Rays in Aluminium. G. B. Bandopadhyaya and A. T. Maitra. *Phil. Mag.* 21. *pp.* 869–880, *May*, 1936.—With a grating spectrometer used at grazing incidence, soft X-ray lines, due to a number of anti-kathodes, are photographed from 7 Å to 25 Å. The mass absorption coefficients are determined accurately for different wave-lengths with a recording microphotometer. The experimental results go to show that Jönsson's universal absorption curve and Stobbe's absorption laws based on quantum mechanics do not represent the present data quite satisfactorily. AUTHORS.

2768. X-Ray Reflections of a Space Lattice. W. Kossel. *Ann. d. Physik.* 25. 6. *pp.* 512–526, *March*, 1936.—The previously described details of the construction and arrangement of the total possible reflections in a given crystal lattice for a given X-ray wave-length are further examined and developed. The directions which lead to a reflection and issue from it are drawn with elaborate details on a sphere. Simple relations exist between the reciprocal lattice and the Ewald's construction of the direction of reflection. As an example a demonstration is given how the system of reflections at a surface-centred cubic lattice with diminishing wave-length is developed. [See Abstracts 2150 and 4614 (1935).] J. J. S.

2769. Reflection of X-Rays by Crystals. C. Mauguin. *Comptes Rendus*, 202, *pp.* 1375–1377, *April* 20, 1936.—The passage of a beam of X-rays through a non-absorbing crystal is considered. The intensities of the transmitted and reflected beams are calculated, the theory leading to two cases. In the first, as the thickness of the crystal is increased the transmitted intensity decreases while that of the reflected ray is augmented. The condition of total reflection is calculated. In the second case the transmitted and reflected intensities are periodic functions of the crystal thickness. When the angle of inclination of the X-rays has certain values all the energy is found in the transmitted beam. C. J. B. C.

2770. Screening Doublets in X-Ray Spectra. A. E. Sandström. *Zeits. f. Physik,* 99. 9–10. *pp.* 622–625, 1936.—It is pointed out that if the relative energies of the $L_{\rm I}L_{\rm II}$ levels are calculated (after Siegbahn) from an absorption edge and from emission lines, then the graph of $\Delta\sqrt{\nu/R}$ against atomic number for the screening doublets does not show the marked discontinuities which are present in the corresponding graph for the $L_{\rm I}L_{\rm II}$ edges. Similar results are mentioned for other screening doublets. L. A. W.

***2771. Automatic Ionisation Spectrometer. W. A. Wooster and A. J. P. Martin.** *Roy. Soc., Proc.* 155*A*. *pp.* 150–172, *May* 18, 1936.—A description is given of an automatic ionisation spectrometer in which a crystal, having been once set, is moved automatically through a pre-arranged series of reflecting positions. The data concerning the reflecting positions is punched on to a 16-mm. kinematographic film which is drawn through the apparatus. The crystal and ionisation chamber are moved together, slowly through the reflecting ranges and rapidly in between them. The instrument is arranged to examine reflections from all planes parallel to a given axis of the crystal. The ionisation current is recorded automatically during the slow movement. Electrometer-triode valves are used either to measure the total charge collected during the transit through a reflecting range or to determine the instantaneous ionisation current at all points during this range. In the latter case one of the valves is acting as a high resistance. Data are given of the performance of the setting mechanism and of the electrical recording. The final record is obtained on 35 mm. photographic paper, but the width is effectively increased to about 210 mm. by using a series of light sources. AUTHOR.

See also Abstracts 2529, 2695, 2784, 2872, 2896, 2897.

HEAT.

CALORIMETRY.

2772. Heat Capacity of Saturated Sodium Sulphate Solution. K. A. Kobe and C. H. Anderson. *J. Phys. Chem.* 40. *pp.* 429–433, *April*, 1936.—The heat capacity of saturated Na_2SO_4 solution from 32·4° to 102·8° C. may be represented by the equation $C = 0{\cdot}803 - 1{\cdot}14 \times 10^{-4}t - 3{\cdot}2 \times 10^{-6}t^2$. The mean heat capacity over this range is 0·780 cal. per gm. The mean heat capacity of saturated Na_2SO_4 solution from 20° to 32·4° C. is: 5·51 cal. per gm. of solution (average) and 7·92 cal. per gm. of solution (initial). The heat of transition of $Na_2SO_4,10H_2O$ is 18,700 cal. per gm. mol. AUTHORS.

2773. Physical Properties of Ductile Titanium. F. M. Jaeger, E. Rosenbohm and R. Fonteyne. *K. Akad. Amsterdam, Proc.* 39. 4. *pp.* 442–469, 1936.—In the specific heat–temperature curve a change in direction occurs at about 850° C. and a sharp peak at 950° C., the latter due to the $\alpha \rightarrow \beta$ transformation. Unlike B, C, and Si, Ti shows no abnormality in respect to its atomic heat, the value rising from 6·5 at 200° C. to 8·9 at 817° C.; for β Ti it is 7·5 independent of temperature. Differential heat-capacity against Cu, plotted against temperature shows minor reproducible points. Resistance-temperature curves are difficult to interpret. Like resistivity, thermo-e.m.f. against gold is greatly affected by minute traces of O_2, which, once introduced, cannot be removed from the metal. Points occur at 620° C. and 720° C., the $\alpha \rightleftharpoons \beta$ change taking place over a range between 860° C. and 924° C. D. R. H.

2774. Heat Capacities of Vanadium and Its Oxides. C. T. Anderson. *Am. Chem. Soc., J.* 58. *pp.* 564–566, *April*, 1936.—The heat capacities of V and its oxides from about 55° to 300° K. are determined and their corresponding entropies calculated. The following table gives the results:

	Entropy (e.u.) $S_{298 \cdot 1}$	Free Energy (cal.) $\Delta F^\circ_{298 \cdot 1}$	Heat of Formation (cal.) $\Delta H^\circ_{298 \cdot 1}$
V	7·01	—	—
V_2O_3	23·5	−282,900	−302,000
V_2O_4	24·5	—	—
V_2O_5	31·3	−405,600	−437,000

AUTHOR.

2775. Heat Capacity of Lead Sulphate at Low Temperatures. C. T. Anderson. *Am. Chem. Soc., J.* 58. *p.* 567, *April*, 1936.—The heat capacity of lead sulphate from about 55° to 300° K. is determined and its entropy calculated as 35·2. AUTHOR.

2776. Heat Capacities of Quartz, Cristobalite and Tridymite. C. T. Anderson. *Am. Chem. Soc., J.* 58. *pp.* 568–570, *April*, 1936.—The heat capacities of quartz, cristobalite and tridymite from about 50° to

300° K. are determined and their corresponding entropies calculated as 10·06, 10·34 and 10·50, respectively. AUTHOR.

2777. Specific Heats of Mineral Oxides. A. Thunet. *Comptes Rendus*, 202. *pp.* 1368–1370, *April* 20, 1936.—The following formulæ, proposed by the author to represent the mean specific heat, S_m, between 0° and t° C., and the true specific heat at t° C. of mineral oxides are found to give results agreeing very closely with experimental results between -273° C and 2600° C. in the cases of silica, limestone and alumina : $S_m = (at + S_0)/(bt + 1)$; $S = (abt^2 + 2at + S_0)/(bt + 1)^2$. Experimental and calculated values differ slightly at temperatures below -200°C. J. S. G. T.

2778. Anomalies in the Specific Heats of Anhydrous $CrCl_3$, $CoCl_2$, $NiCl_2$. O. Trapeznikowa, L. Schubnikow and G. Miljutin. *Phys. Zeits. d. Sowjetunion*, 9. 2–3. *pp.* 237–253, 1936. *In German.*—The authors have measured the specific heats of anhydrous $CrCl_3$, $CoCl_2$ and $NiCl_2$ within the temperature range of 14° to 130° K. $CrCl_3$ exhibits anomaly at 16·8° K. and $CoCl_2$ at 24·9° K, while $NiCl_2$ has two anomalies at 49·6° and 57·0° K. The position of the second maximum is not constant and depends on the lowest temperature to which the salt has been cooled. Thermal hysteresis has been observed between 56° K and 63° K, but only for $NiCl_2$. The paper is replete with experimental details and data. H. H. Ho.

***2779. Gas Calorimeter Based on the Principle of Thermal Balance. R. W. Keith.** *Mechanical Engineering*, 58. *pp.* 225–229, *April*, 1936.—The instrument consists of two chambers and a heat exchanger. Air is drawn through one tube of the exchanger into the primary chamber where it is heated by the combustion of the test gas. It passes through another tube of the exchanger, where its temperature drops to that at the primary inlet, into the secondary chamber where its temperature is again increased by the standard heat source in that chamber. The chambers are fitted with a differential thermometric device which is adjusted to zero by varying the heating in the second chamber. Under balance conditions the fluid current undergoes the same temperature rise in both chambers, and, therefore, the heating value of the test gas is known in terms of the standard, The instrument has a number of advantages ; calibrated thermometers are not required ; it compensates automatically for such disturbing influences as heat losses, change in room-temperature, etc., and it is easily adapted for automatic recording. C. J. B. C.

See also Abstracts 2782, 2887.

CONDUCTION.

***2780. Thermal Conductivity of Liquids. O. K. Bates.** *Indust. & Engin. Chem.* 28. *pp.* 494–498, *April*, 1936.—Improvements have been made in the apparatus previously used [see Abstract 3078 (1933)] for the measurement of the thermal conductivity of liquids. The new apparatus is illustrated and the modifications are described. The liquid under test, in the form of a disc (50 mm. thick), is heated from above. The heat flow through the central area is measured, the outer liquid serving as a guard ring. Thermocouples are stretched in isothermal planes in the liquid. The true conductivity and temperature coefficient is determined over a range of from 10° C. to 80° C. in a single experiment. Results are given for distilled water and mixtures of water and glycerin. The thermal conductivity of glycerin has the constant value of 0·00068 c.g.s. units over this temperature range, whilst that of water increases linearly from 0·00138 at 10° C. to 0·00163 at 80° C. R. W. P.

2781. Thermal Conductivity of Liquid Helium. W. H. Keesom and (Miss) A. P. Keesom. *Physica,* 3. *pp.* 359–360, *May,* 1936. *In English.*—A preliminary note on experiments now in progress which show that the thermal conductivity of liquid He increases to such an extent below the λ-point to justify considering liquid He II as supra-heat-conducting. At 3·3° K. the conductivity of liquid He is 6×10^{-5} c.g.s. units, but at 1·4° K. and 1·75° K. a preliminary value of the order of 190 c.g.s. units has been obtained for liquid He II. This is about 200 times the thermal conductivity of Cu at normal temperatures, and is the highest value yet obtained. R. W. P.

***2782. Thermal Constants of Setting Concrete. H. Sheard.** *Phys. Soc., Proc.* 48. *pp.* 498–512, *May* 1, 1936.—The conductivity was measured by the concentric-cylinder method, the heat evolved by the specimen being eliminated by keeping it in a bath constantly-maintained at its own temperature by a control-specimen operating a relay to work the bath-heaters. The diffusivity was measured by transferring the specimen for a few minutes to a bath at about 10° C. below the controlled bath, replacing it in the controlled bath and taking readings of axial and surface temperatures. The results are considered to be accurate to within 1 %, the apparatus being tested by employing a cylinder of water, when good agreement was obtained with the known data for water. Convection was prevented by ramming cotton-wool into the cylinder. Concrete mixed from cement, sand ($\frac{1}{8}'' - \frac{1}{100}''$) and water in the ratio 1 : 6 : 0·6 was tested, and it was found that both with ordinary and rapid-hardening cement the specific heat shows a slight decrease, but the conductivity and diffusivity show a slight increase with time, and are always higher than for dry concrete. This is considered to be due to the humidity of the specimens, which simulated practical conditions. R. F. A.

See also Abstracts 2476, 2540, 2541, 2550, 2788.

CONVECTION.

2783. Heat Interchange between a Rapidly Moving Hot Body and Air. E. Brun, M. Jampy and R. Lecardonnel. *Comptes Rendus,* 202. *pp.* 1256–1258, *April* 6, 1936.—At slow speeds a body in which W heat units are generated communicates this heat to the air according to the equation $W = h_1 S\,(t - t_a)$, where t = body temperature and t_a = air temperature. Owing to frictional heating at high speeds the body would be heated when W = O, and, if t_o is the temperature it would then attain, the heat dissipation is given by $W = h\ S\,[(t - t_a) - (t_o - t_a)]$; $(t_o - t_a)$ is proportional to the square of the speed, v, hence, $(t - t_a) = W/Bv^n + Av^2$, where $n < 1$. $(t - t_a)$ has a minimum value when $v = (nW/2\ AB)^{1/(n+2)}$. R. W. P.

See also Abstracts 2540, 2541.

DILATATION.

2784. X-Ray Measurement of Expansion Coefficient of Be and Sn. G. F. Kossolapow and A. K. Trapesnikow. *Zeits. f. Krist.* 94. *pp.* 53–59, 1936.—The authors have employed a method similar to that used for Cd, but the piece of material in the case of Be was carefully cut and prepared in the form of a plate. Though the results of the measurements are less accurate than those obtained in the case of Cd the X-ray photographs show the lengthening of the principal axis at various temperatures, and a table is given of the lattice constants of Be at these temperatures. Similarly the lattice constants obtained in the case of Sn are given. J. J. S.

***2785. Thermal Expansion of Solids at Low Temperatures. H. Adenstedt.** *Ann. d. Physik*, 26. 1. *pp.* 69–96, *May*, 1936.—The relationship between temperature and the coefficient of cubical expansion of regular crystallised monatomic materials is defined by a formula due to Gruneisen whereby at low temperatures it is proportional to C_v. Simon and Bergman found certain anomalies for Fe, Cu and Ni. For polyatomic materials where the molecular heat is defined according to the Debye function the formula also is valid. The present work describes an investigation of the anomalies found by other workers, and in addition to the metals above mentioned is extended to zinc blende, lithium fluoride, calcspar and aragonite, as also sal-ammoniac. A metal thermostat is described which allows by means of (Fizeau) interference rings, the measurement of the coefficient of expansion to be achieved from 0° to − 195° with an error of only 0·01° from the constant temperature. The coefficients of expansion for the metals Fe, Ni and Cu were determined over the temperature range from 0° to that of liquid air and the Simon and Bergmann anomalies were not found. For zinc blende the investigation is extended to − 253° and at low temperatures a negative value is found. The expansion coefficient was approximately proportional to the value obtained from the C_v value. For LiF, using the value of C_v calculated from the Clusius and Goldmann method, it is found that for medium temperatures the Gruneisen relationship existed, but at lower temperatures there are large divergences therefrom. These are perhaps related to the Clusius and Goldmann contradictions of the Debye T^3 law for the determination of C_v. For calcspar and aragonite it is found that the latter, for decreasing temperatures, assumes the condition of a monatomic solid body, and acts as such, while calcspar does not do so but below − 172° shows a negative volume expansion. Under ordinary circumstances the coefficient of expansion in relation to temperature exhibits a linear relationship. For NH_4Cl crystals between 0° and − 195° there is a clearly defined inversion point at − 31°. S. G. B.

See also Abstract 2884.

MELTING AND BOILING POINTS.

2786. Orthobaric Azeotropes. M. Lecat. *Ann. Soc. Sci. de Bruxelles*, 56. *pp.* 41–54, *April* 3, 1936.—Results are given for 434 binary systems, formed by 80 esters and 63 halogen derivatives of hydrocarbons. There are 148 definite instances of azeotropism, in 23 of which the azeotropism is negative. Tabular data are presented in a similar manner to that adopted in an earlier paper dealing with ester-hydrocarbon mixtures. [See Abstract 752 (1936).] R. W. P.

2787. Liquid State and Interatomic Forces. S. Franchetti. *Accad. Lincei, Atti*, 22. *pp.* 585–592, *Dec.* 15, 1935.—Continuing a previous study [see Abstract 1748 (1936)] the author tests his theory of the relationship between the form of the law of interatomic force and the interatomic distances in liquid and solid at the fusion point by calculations by two methods of the difference $r_l - r_0$, where r_l is the interatomic distance in the liquid at the fusion point and r_0 is the interatomic distance at which the interatomic force is zero (repulsive and attractive forces equal). The two methods give results in agreement and certain deductions are made as to the form of the curve relating interatomic force with distance. W. S. S.

***2788. Drying Processes. E. Schmidt.** *Zeits. f. ges. Kälte Ind.* **43.** *pp.* 75–80, *April,* 1936.—The evaporation of water from a saturated surface can be derived from a knowledge of the heat transfer under identical conditions, since Lewis's relation $x = \alpha/C_p$, where x is the evaporation coefficient, α the heat transfer coefficient and C_p the specific heat of air at constant pressure, holds approximately for water. The rate of drying is subsequently governed by the rate at which water can diffuse to the surface. An apparatus is described which has been used to determine the rate of diffusion of water vapour through slabs of materials such as wood. The wetter the wood the greater is the rate of diffusion, and to avoid surface drying moist air should be used initially. Leather and tracing paper behave similarly. Thermal conductivity also plays a part in drying processes, and another apparatus is described which can be used to measure the thermal conductivity of materials having a definite water content. Results given for pine, fir and beech wood show that in each case the conductivity increases with increase in water content. R. W. P.

***2789. Rapid Micro-Method for the Determination of Melting Point. R. C. Ray and V. Dayal.** *Faraday Soc., Trans.* **32.** *pp.* 741–743, *May,* 1936.—A small piece of Pt wire bent V-shaped to form a point, is electrically heated. The current is variable and is measured by an accurate ammeter. The Pt point is made to touch a particle of the substance under investigation, and the current through the wire is varied until the particle melts, the point of fusion being observed through a telescope. A number of inorganic substances of high melting points (500–900° C.) are examined with satisfactory results. The experimental error is estimated at about ± 4° C. The advantage of the method is the small quantity of substance required. C. J. B. C.

See also Abstracts 2481, 2513.

TEMPERATURE, MEASUREMENT OF.

2790. True Temperature of a Luminous Flame by Kurlbaum's Method. Y. Godron. *Rev. d'Optique,* 15. *pp.* 56–62, *Feb.,* 1936.—Using a direct reading disappearing filament pyrometer with a red glass of effective wave-length 0·656 μ the author determined the curve connecting pyrometer reading with the current through a ribbon filament lamp on which the pyrometer was sighted (*a*) with no luminous flame, (*b*) with one, two or three Hefner elements interposed. The curves obtained intersect at a point corresponding to the true temperature of the flames, but it is observed that the curves form an asymmetric pencil with respect to their point of intersection. A theoretical explanation of this feature is advanced which yields calculated curves conforming in shape to those observed. W. S. S.

***2791. Room Thermostat. W. E. Bardgett and A. H. Jay.** *Engineering,* 141. *pp.* 418–419, *April* 17, 1936.—A description of a thermostat designed to maintain the temperature of a room of 27 ft. × 21 ft. constant to within ± 1° C. over long periods and to within ± 1° C. at any particular point. A long stainless steel strip is fixed to the wall in such a manner that its change of length with temperature operates a relay by

means of a mechanical magnifying device. The contacts are mercury and the first relay circuit at 4 V operates a contactor for 20 A at 250 V, d.c. Heaters are fixed to the walls and are rated at 750 W each. A circuit diagram, outline of heater and plan of room are given, together with a table of temperatures in different parts of the room on different days.
E. H. W. B.

See also Abstract 2919.

THERMOCHEMISTRY.

2792. Cold Flames in Pentane-Oxygen Mixtures. B. V. Aivazov and M. B. Neumann. *Acta Physicochimica*, 4. 4. *pp*. 575–606, 1936. *In English*.—The conditions controlling the production of cold flames in pentane-O_2 mixtures of various composition are studied. The region of production and the influence of the diameter of the vessel and of the composition of the mixture are determined. It is found that in addition to a small yield of CO and CO_2, aldehydes up to 34 % and peroxides up to 13 % are formed in the cold flames of pentane-O_2 mixtures. It is shown that the negative temperature coefficient of the reaction is connected with the temperature limits of the existence of cold flames. AUTHORS.

2793. Explosive Limits of Gaseous Mixtures. M. Rivin and A. Sokolik. *Acta Physicochimica*, 4. 2. *pp*. 301–316, 1936. *In French*.—The limits of explosion are determined for mixtures of H_2 with air and O_2 and, contrary to other workers, an explosive wave is shown to occur in mixtures of H_2 and air. J. K.

2794. Explosion Waves in Gases. E. Jouguet. *Comptes Rendus*, 202. *pp*. 1225–1229, *April* 6, 1936.—A study is made of the initial state of the wave immediately following an explosion [see Abstract 2299 (1936)], in which the formulæ of Taffanel and Dautriche are adopted for the propagation of detonations in explosive solids. Hugoniot's hypotheses are also discussed with respect to the impact of two fluid media and modifications are suggested. Experimental and calculated values are given for the velocities of explosion waves produced in H_2 and CO_2 and are in excellent agreement. [See following Abstract.] H. H. Ho.

2795. Explosion Waves in Gases. E. Jouguet. *Comptes Rendus*, 202. *pp*. 1320–1322, *April* 15, 1936.—This paper supplements a previous publication [see preceding Abstract] with respect to hypotheses and results. §1, deals with the theory of the explosive wave in explosive solids, and discusses the value and limitations of the theory of Taffanel and Dautriche which was utilised and extended by the present author. It is pointed out that the explosive wave is very probably a collision wave, and that incomplete combustion produces a medium which follows the wave and for which the theory is not well known. The author concludes that the above theory will give the form of the formula, but that the coefficients must be experimentally determined. The data of the previous paper have been calculated from this standpoint, viz., the velocities of the explosive wave and of the collision wave produced in the air. §2, considers the velocity of the issuing collision wave and finds theory to be in agreement with experiment. §3, is devoted to an analytical discussion of the theory, and §4, deals with Hugoniot's hypotheses which give qualitative results analogous to those found by the author. H. H. Ho.

See also Abstracts 2747, 2762, 2763, 2774, 2790, 2800, 2851, 2856, 2884.

THERMODYNAMICS.

2796. Isotherms of Ethylene between 0° and 150° C. A. Michels, J. de Gruyter and F. Niesen. *Physica,* 3. *pp.* 346–351, *May,* 1936. *In English.*—The values of $(pv_{t+12\cdot5} - pv_{t-12\cdot5})/25$ are calculated and plotted. From the character of these curves the conclusion can be drawn that the specific heat c_v increases with increasing density to pass through a maximum at the critical density as was also found for CO_2. AUTHORS.

2797. Specific Heat and Constitution of Liquids. L. Brillouin. *J. de Physique et le Radium,* 7. *pp.* 153–157, *April,* 1936.—Treating a liquid as the limiting case of a solid without rigidity, the specific heat at constant volume of a monatomic liquid is calculated, and found to be 2R, intermediate between that of solids, 3R, and gases, 3R/2. Real monatomic liquids have a specific heat about 3R near the melting point, falling to 2R near the critical point. It is suggested that a liquid has a crystalline microstructure at low temperatures, the ideal liquid state being realised only near the critical point, in agreement with recent work on liquids. C. J. B. C.

2798. Application of Thermodynamics to Chemical Equilibria. W. Mund. *Ann. Soc. Sci. de Bruxelles,* 56. *pp.* 15–34, *April* 3, 1936.—Certain points in Gibbs' thermodynamical theory are clarified. The main points discussed are as follows: (1) The theory of thermodynamic potential and of affinity imply uniformity of temperature and of pressure throughout the transformations; (2) The principle of Le Chatelier can be deduced directly and simply without employing the thermodynamic functions; (3) Equality of partial molecular potentials can be readily demonstrated by considering the reversible characters of the pressure and temperature of a reaction; (4) Uncompensated heat is independent of pressure and temperature variations; (5) Theoretical results conforming with experience are obtained by postulating that the partial molecular thermodynamic potential of a constituent (i) of a mixture is expressed by $\mu_i = \mu'_i + RT \log g_i X_i$, in which g_i tends towards the value unity as X_i tends towards the value zero. J. S. G. T.

See also Abstracts 2774, 2775, 2776, 2825.

VAPOUR PRESSURE.

2799. Vapour Pressures of the Xylenes and Mesitylene. L. S. Kassel. *Am. Chem. Soc., J.* 58. *pp.* 670–671, *April,* 1936.

2800. Comparative Method for Measuring Aqueous Vapour and Dissociation Pressures. E. M. Collins and A. W. C. Menzies. *J. Phys. Chem.* 40. *pp.* 379–397, *March,* 1936.—A method is described for the measurement of aqueous vapour and dissociation pressures of salts by equilibrium with aqueous H_2SO_4 solutions. The vapour pressures assumed for the H_2SO_4 solutions are those determined by Collins [see Abstract 737 (1934)]. A test tube containing the salt and a small weighing bottle of the H_2SO_4 is evacuated and sealed at a low temperature. It is then maintained at the experimental temperature, which need not be controlled to better than 0·5° C., until equilibrium is reached. After closing the weighing bottle it is removed and the concentration of the H_2SO_4 determined gravimetrically. Results are given up to 130° C. for anhydrous and various hydrated forms of $CuSO_4$, the chlorides of Ba, Sr and Ca, and the bromides of Ba and Sr. For each salt pressure equilibrium values are tabulated for the univariant and invariant systems formed with water. Heats of vaporisation of water from the several hydrates and from their saturated solutions are evaluated. R. W. P.

See also Abstract 2856.

ACOUSTICS.

2801. Chladni Figures upon Square Plates. R. C. Colwell. *Frank Inst., J.* 221. *pp.* 635–652, *May,* 1936.—Continuing his study of the vibrations of square plates [see Abstract 5120 (1932)] the author describes a new series of Chladni figures which may be predicted by regarding a square plate as made up of two isosceles triangles or of two rectangles. In the former case the patterns show symmetry about a diagonal and in the latter about a median line parallel to one of the sides. What is termed "180° symmetry" is also described and is obtained by rotating one half of the pattern through 180°. The author remarks that for any one frequency a number of different patterns are possible and are obtained by varying A and B in the following approximate equation for the nodal lines : $A\cos\frac{m\pi x}{a}\cos\frac{n\pi y}{a}+B\cos\frac{n\pi x}{a}\cos\frac{m\pi y}{a}=0$. Photographs of a number of patterns which illustrate the text are given. J. E. R. C.

2802. Exact Measurements on Primitive Musical Instruments. M. Bukofzer. *Zeits. f. Physik,* 99. 9–10. *pp.* 643–668, 1936.—The instrument investigated was that known as Pan's pipes, The frequencies of its notes were determined by an electrical tone generator with an accuracy of 1 in 400. The notes were produced by mouth and also with the aid of a blow-pipe. When using the latter, the air current must be directed to the mouth of the pipe to make an angle of 15° to 20° with the plane of the mouth. The different causes which change the frequency of the pipe, such as the angle mentioned, the speed of the air current, the effective lengthening of the tube when sounded by the mouth, and the overtones of the pipes and their variation are investigated in addition to the changes in the end-correction of the pipes according to the different methods of sounding. The results give no support to the "wind fifth" theory of v. Hornbostel. G. E. A.

2803. Ultrasonic Velocities in Organic Liquids. Part II. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 285–289, *March,* 1936.—The paper contains determinations of ultrasonic velocities in 14 organic liquids, some of them being di-esters, by the method of diffraction of light by h.f. sound waves. Included are also adiabatic compressibilities for these compounds, calculated therefrom. [For Part I see Abstract 784 (1936).] AUTHOR.

2804. Diffraction of Light by Ultrasonic Waves. R. Lucas. *Comptes Rendus,* 202. *pp.* 1165–1166, *March* 30, 1936.—Raman and Nath's theory of luminous intensity distribution in the diffraction spectra produced by ultrasonic waves is tested experimentally. The author concludes that whilst the theory is satisfactory when the ultrasonic beam is narrow, it does not hold for the usual experimental conditions. The only theories which take into account all the elements of the problem are those of Brillouin (Paris, 1933) and of the author [see Abstract 1145 (1933)]. G. E. A.

2805. Changes in Frequency of Light with Diffraction by Ultrasonic Waves. F. Levi. *Helv. Phys. Acta,* 9 .3. *pp.* 234–244, 1936. *In German.*—The changes of frequency which light undergoes when diffracted by progressive and stationary sound waves are derived from a generalisation of Raman and Nath's theory of the diffraction of light by ultrasonic waves. The results are compared with the experimental results of Bär and Ali. [See Abstract 1779 (1936).] G. E. A.

***2806. Absorption of H.F. Sound in Oxygen Containing Small Amounts of Water Vapour or Ammonia. V. O. Knudsen and L. Obert.** *Acoustical Soc. of America, J.* 7. *pp.* 249–253, *April,* 1936.—Using a new technique the author has extended his measurements upon the absorption of h.f. sound in gases to higher frequencies (up to 34,000 ~). The gas is contained in a small steel box and sound generated in the box by a magnetostriction oscillator. The intensity of the sound generated in the box is measured and hence the sound absorption in the gas determined. The results of the measurements confirm the earlier results [see Abstract 5390 (1933)], *viz.*, that the absorption is a maximum at a certain frequency which depends upon the amount and kind of the gaseous impurity and that this frequency increases almost linearly with the concentration of most impurities, but in the case of water impurity is a quadratic function of the concentration. This latter fact suggests that a collision of an O_2 molecule with two molecules of H_2O is more efficient in producing a transition within the molecule than is a collision with a single H_2O molecule. The theoretical value of the maximum absorption per unit wave-length agrees within experimental error with the measurements. Other measurements have shown that CO_2 and H_2 are also absorptive in the frequency range 7000 ~ to 34,000 ~. J. E. R. C.

2807. Influence of Ultrasonic Waves on Chemical Reactions. S. Sokolow. *Techn. Phys., U.S.S.R.* 3. 2. *pp.* 176–182, 1936. *In French.*—In some cases, ultrasonic vibrations induce coagulation of aqueous colloids, *e.g.*, with SiO_2, $Fe(OH)_3$ from interaction of $FeCl_3$ and NH_4OH, albumen ; in other cases, *e.g.*, $Fe(OH)_3$ from hydrolysis of $FeCl_3$ with boiling water, Ag, contradictory results are reported ; while in others dispersion of a coagulated colloid results, *e.g.*, with CdS, S from interaction of H_2S and H_2SO_3. Apparently the rate of formation of relatively large particles is unaffected, but if coagulation has already occurred, dispersion may result. Ultrasonic waves do not affect crystallisation of sugar or supersaturated Na_2SO_4. If a catalyst is already present, the inversion of cane sugar is accelerated, otherwise the vibrations have no effect. D. R. H.

2808. Sound Field of Rotating Airscrew. L. Gutin. *Phys. Zeits. d. Sowjetunion,* 9. 1. *pp.* 57–71, 1936. *In German.*—The paper contains a theoretical investigation of the sound field produced by an airscrew. The field is unsymmetrical, having a maximum at 115° to the direction of flight, and another, much weaker, maximum at 40°. The theoretical polar curve of the field for the first partial of the low-frequency sound of the screw is in good agreement with that of Paris [see Abstract 2516 (1932)] ; the agreement with Kemp's curve [see Abstract 3359 (1932)] is not so good. The theoretical values found for the sound output in the two partials are regarded as satisfactory, *viz.*, 34 and 30 W for the first partial and 6·5 and 4·7 W for the second, as compared with Kemp's values 17·8 and 7·4. G. E. A.

***2809. Two-Valve Microphone Amplifier Unit. T. S. Littler.** *Wireless World,* 38. *pp.* 380–382, *April* 17, 1936.—A small portable hearing-aid is described which embodies a carbon microphone combining high sensitivity with a good frequency-response, while the amplification afforded by its two valves is such that it will prove of considerable help even in cases of serious deafness. AUTHOR.

***2810. Hearing Aids for the Deaf. T. S. Littler.** *Journ. Sci. Instruments,* 13. *pp.* 144–155, *May,* 1936.—An account is given of the principles involved in the design, use and testing of apparatus used for hearing aid purposes with partially deaf subjects. Designs are given of a number of aids that have been found particularly useful, especially with seriously deaf subjects. These are designed both for individual use and for class teaching of deaf children. The importance of a knowledge of the effective amplification of such apparatus is emphasised, and methods of determining this subjectively and objectively are described. Results are given of a number of tests on typical apparatus under working conditions. AUTHOR.

2811. Sounds with Continuous Frequency Spectra. H. Thiede. *E.N.T.* 13. *pp.* 84–95, *March,* 1936.—The author shows how to calculate the frequency distribution of the energy in the continuous spectra of specified impulses, and then defines a statistical noise for experimental comparison with the continuous noise emission associated with (1) radioactive α-ray bombardment, (2) the Barkausen effect in magnets, (3) carbon noise in transmitters, and (4) Schrot effect in valves. Energy distribution curves for each of the sources are given, together with that in elementary bandwidths. The author then records the decay of reverberant sound with a pure tone, a warble tone, and a noise, with increasing uniformity. By taking series of reverberation period measurements, the author shows that the warble and the continuous tones give substantially the same result, the latter giving a much smaller probable error. L. E. C. H.

2812. Acoustic Absorption. E. Meyer. *E.N.T.* 13. *pp.* 95–102, *March,* 1936.—The author considers the possibility of acoustic absorbing materials being non-porous, but at the same time undamped, the desirable features being hygienic and paintable. A large number of curves are given for the coefficient of absorption over the audio-frequency range, the method of measurement being to send an impulse of the desired frequency past a microphone to the reflecting specimen, the reflected wave again passing the microphone; from the record of the microphone output, the absorption coefficient can be deduced. L. E. C. H.

See also Abstracts 2705, 2794, 2903, 2912, 2913.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***2813. Detector for Audio-Frequency Bridges. N. I. Adams, Jr.** *Rev. Sci. Instruments*, 7. *pp.* 180–181, *April*, 1936.—A two-stage, transformer coupled amplifier, with a microammeter of the rectifier type in the output circuit. The instrument will indicate balance to 5μV at frequencies from 500 to 7000 ∼. L. H.

***2814. Electro-Mechanical Equivalents. G. Gamburcev.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 4. 8–9. *pp.* 319–322, 1935. *In French.*—In the representation of mechanical systems by electrical circuits and *vice versa* certain difficulties arise which are considered at length in this paper. Particular consideration is given to the equivalence of mass and inductance and a new equivalent for inductance is proposed consisting of a mass suspended from a rigid point by means of a rigid member articulated in the centre. From these and other considerations a new arrangement for a seismograph is suggested. F. S. B.

See also Abstracts 2704, 2902.

CONDUCTION AND DISCHARGE IN GASES.

2815. Cloud-Chamber Investigation of Electrical Discharge through Gases. E. Flegler and H. Raether. *Zeits. f. Physik*, 99. 9–10. *pp.* 635–642, 1936.—Examination of the electrical discharge through gases is made with a cloud chamber, the electrode separation being about 2·5 cm. The nature of the discharge, which begins in canal form and which quickly passes over into an electron " avalanche," is the same for dry and moist gases. The cloud-chamber photographs indicate that the transition to the self-maintained discharge is due to some secondary photoelectric effect. F. C. C.

2816. Electric Breakdown and Gas Discharge. W. Rogowski. *Zeits. f. Physik*, 100. 1–2. *pp.* 1–49, 1936.—A lengthy theoretical paper. The first part deals briefly with breakdown without consideration of the space charge. The second part is a detailed study of breakdown taking full account of the space charge, utilising theoretical and available empirical data. The examination includes a study of the breakdown process and the effect of ionisation, secondary influences, static and impulse breakdowns. The third part deals with the relation between breakdown and gas discharge and gives the basis and results of a rigorous theory. R. L.

2817. Dependence of the Voltage of a Glow Discharge on the Length of its Positive Column. W. Holtz and J. Kömmnick. *Zeits. f. Physik*, 99. 3–4. *pp.* 252–253, 1936.—The author has previously found that with a very short positive column deviations from the normal phenomena occur. If in a gas discharge the length of the positive column is changed by the amount δl, then the voltage changes also by an amount $\delta F = E\delta l$, if E signifies the field strength in the positive column. This simple relation, however, only holds good so long as the positive column possesses a certain minimum length. If this minimum length is exceeded then the decrease of the excitation voltage is greater than the product

E δl. The glow discharge in A has been investigated to find the connection between the length of the positive column and the excitation voltage at various strengths of current. It is found that at definite pressure and current strengths the same phenomena as in the Hg arc occur, though in a lesser degree. J. J. S.

2818. Temperature of Helium in the H.F. Discharge. J. Roig. *Comptes Rendus*, 202. *pp*. 1044–1046, *March* 23, 1936.—For various voltages the temperature remains in the vicinity of 200° C. W. R. A.

2819. Effect of Metastable Atoms on Electron Temperature in the Positive Column. G. Spiwak and E. Reichrudel. *Physica*, 3. *pp*. 301–306, *May*, 1936.—Previous work on the effects of adding small quantities of impurities to the gas in a discharge tube on the characteristics of the discharge, is summarised. The probe characteristics of a discharge in pure Ne and in Ne with a small quantity of metastable A are investigated. It is shown that the elimination of the metastable atoms from the discharge results in an increase of the electron temperature by a factor 1·89. J. E. R.

2820. Electron Energies and Excitation in the Helium Positive Column. F. L. Jones. *Phys. Soc., Proc.* 48. *pp*. 513–524; *Disc.*, 525–526, *May* 1, 1936.—Discusses the results of previous investigations on the intensities of the lines emitted from He discharges and suggests a distribution function for the energies of the electrons to account for these. The variation of the line intensities with pressure of the gas is calculated, and curves drawn representing relative intensities of the various lines at different pressures. These curves are compared with those representing observed variations of the intensities. The agreement between the two sets supports the conclusion that the energy distribution of the electrons in He is of the form suggested. It is concluded that the energy distribution of the vast majority of the electrons in the He positive column is determined by the process of diffusion and the mean loss of energy in elastic collisions with atoms of the gas; but a small fraction (2×10^{-3} of the total number) form a group with an energy distribution given by Maxwell's formula corresponding to the same mean energy. This small group is of predominating influence in the He discharge at high pressures as far as excitation and ionisation are concerned. A. H.

2821. Interpretation of Critical Potentials of C^+ and C^{++} Ions in Gaseous CO_2 assuming $D(CO) = 6 \cdot 9$ Volts. R. Schmid. *Zeits. f. Physik*, 99. 9–10. *pp*. 626–632, 1936.—Assuming the energy of dissociation of CO to be 6·9 V [see Abstract 1664 (1936)] the potentials of the C^+ and C^{++} ions relative to the ground state of CO_2 are calculated to be 28·9 and 54·4 V respectively, good agreement being thus obtained with the observed values (28·3 ± 1·5 and 55 ± 3 V respectively) from electron impact experiments. The existing experimental data on the energies of the different modes of decomposition of CO_2, as derived from absorption continua, predissociation in absorption bands and critical potentials, are expressed in a diagram together with the calculated dissociation energies to $C + O + O$ and $CO + O$. It is concluded that the energy of the complete dissociation $CO_2 + 16 \cdot 7\ V \rightarrow C(^5S) + O(^3P) + O(^3P)$ is made up of two nearly equal dissociation components $CO_2 + 5 \cdot 47\ V \rightarrow CO(X^1\Sigma) + O(^3P)$ and $CO(a^3\Pi) + 5 \cdot 22\ V \rightarrow C(^5S) + O(^3P)$ together with the excitation energy $CO(X^1\Sigma) + 6\ V \rightarrow CO(a^3\Pi)$. [See also Abstract 1800 (1936).] L. A. W.

2822. Production of Radiation and Ionisation from Helium Atoms by Potassium Positive Ions. Ann Catherine Davies. *Roy. Soc., Proc.* 155*A. pp.* 123–141, *May* 18, 1936.—The excitation and ionisation of neutral He atoms by a collimated beam of positive K ions of controlled energy is investigated by applying an electric field transversely to the positive ion beam to drive electrons resulting from collisions to a collecting electrode. The usual method is employed for discriminating between electrons resulting from ionisation by collision, and electrons arising photoelectrically from electrodes by radiation produced by collision of K ions and He atoms. Both radiation and ionisation are found to be produced and their combined effect begins to be detectable at about 450 V. The results indicate a much smaller production of ionisation than has been recorded by previous investigators, particularly at low voltages. Possible causes of the discrepancies among the results of different investigators are discussed. An estimate from the present experiments of the number of electrons produced per K ion per cm. of path at 1 mm. pressure by 750-V ions is $8{\cdot}7 \times 10^{-3}$, and by 3000-V ions is $2{\cdot}3 \times 10^{-1}$. AUTHOR.

***2823. New Methods in Mass Spectroscopy. A. J. Dempster.** *Am. Phil. Soc., Proc.* 75. 8. *pp.* 755–766, 1935.—A description is given of a new source of ions, using h.f. oscillating sparks between metal electrodes, giving rise to highly charged ions. These are found to be given by all the commoner elements tried. The new ion sources are developed for use in conjunction with an arrangement for producing a perfect focus, with regard to energies and direction, by means of a combined electric and magnetic field. With a view to increasing the accuracy of atomic mass determinations results of isotopic investigations on Au, Ce, Cd, Pt, Rh, Pd, and U are reported. N. M. B.

2824. Collision of Corpuscular Rays with Solid Bodies. K. Sommermeyer. *Ann. d. Physik*, 25. 6. *pp.* 481–511, *March*, 1936.—The statistical theory of kathode pulverisation (produced by local heating) is accurately formulated. It is found that the pulverising particles must be emitted by rebounding places, with temperature near the critical temperature of the solid body. The pulverisation must increase with decreasing critical temperature and is inversely proportional to the heat conductivity of the rebounding place. These consequences are contrasted with the consequences of the impulse theory. An experimental investigation of the pulverisation by argon canal rays of 10–15 kV establishes the statistical theory. (*a*) The particles are emitted according to Knudsen's cosine law. (*b*) For the determination of temperature on the pulverising particles the degree of dissociation of pulverising KI into K^+ and I^- is measured. It is found to be 10^{-4}. Thus a temperature of about 3000° Abs. is found by thermodynamical calculation. (*c*) To establish the influence of the conductivity of heat on the absolute amount of the pulverisation, the pulverisation of metals and insulators is compared. J. J. S.

2825. Synthesis of Ammonia with Kathodically Pulverised Lead. P. Jolibois and F. Olmer. *Comptes Rendus*, 202. *pp.* 1268–1269, *April* 6, 1936.—When a mixture of $N_2 + 3H_2$ at low pressure is passed across a stream of kathodically pulverised Pb the production of NH_3 is approximately proportional to the energy expended. The yield per watt increases but the limiting percentage decreases as pressure increases. Thus with pressures of 2, 4, 8, and 20 mm. Hg the numbers of watts required to produce 1 cc. NH_3 are respectively 1·80, 1·08, 0·83 and 0·55, while the limiting percentages of NH_3 produced are 21·5, 11·5, 10·1 and

6·5 to which the thermodynamically corresponding equilibrium temperatures are 38°, 66°, 85° and 118°. C. A. S.

✱2826. Ionisation and Luminescence of Atomic Jets in a High Vacuum. R. Planiol. *Comptes Rendus*, 202. *pp.* 1032–1033, *March* 23, 1936.—In an earlier paper [see Abstract 1776 (1935)] the author described a method of producing a beam of positive ions by bombarding an atomic beam with electrons. The apparatus suffered, however, from the blocking of one of the limiting diaphragms after working for some time. A new and more powerful apparatus is now described. J. E. R. C.

2827. Determination of Electron Velocity by Means of Probe Measurements. W. Denecke and E. Lübcke. *Phys. Zeits.* 37. *pp.* 347–350, *May* 1, 1936.—From Boltzmann's relations for electron concentration it is found possible with a very short probe, by measurements at several points or with different probe lengths, to determine the true velocity distribution of the electrons from the semi-logarithmic characteristic of the space potentials and probe currents. The ordinary probe characteristic does not give the true velocity distribution, but usually appreciably higher values. With long probes the characteristic is generally found to exhibit a kink and above this point gives the true velocity. The higher velocities are attributed to the presence of layers on the probe stem and on the walls of the chamber. This results in the measured values of electron concentration being too low. In the Hg discharge it is found that there is only a slight excess of positive ions. This is counterbalanced by a smaller number of hard negative ions, as previously shown by Lübcke and recently investigated by Arnot. A. W.

See also Abstracts 2685, 2761, 2872, 2901.

CONDUCTION IN SOLIDS AND LIQUIDS.

2828. Electrical Conduction by Convection and Diffusion. Part I. F. Borgnis. *Zeits. f. Physik*, 100. 1–2. *pp.* 117–140, 1936.—A mathematical paper in which the unipolar conduction in a dielectric medium is studied with special reference to the diffusion, assuming that the carriers of electricity are released from the electrodes. Qualitative considerations of the nature of the solution are given and an investigation of the relevant boundary conditions. The course of the current-voltage characteristics and the relation between initial equations and Boltzmann's principle are discussed. Mathematical analyses are made for various cases for both symmetrical and asymmetrical cases and approximations are given for small currents. R. L.

✱2829. D.C. Potentiographs. W. Geyger. *A.T.M.* 5. *T*38–*T*40, *March*, 1936.—Review of methods of automatic operation of the controls of d.c. potentiometers so as to maintain balance of a varying p.d., and to record its variations. P. V.

✱2830. Automatic Potentiometer for Thermal Analysis. R. J. M. Payne. *Journ. Sci. Instruments*, 13. *pp.* 158–161, *May*, 1936.—Details are given of the auxiliary apparatus (including a photo-cell) which enabled the automatic working of a thermal curve potentiometer [see Abstract 5163 (1935)] to be achieved. AUTHOR.

2831. Effects of Heat and Ultra-Violet Light on Crystal Rectification. B. K. Sen. *Indian Journ. Phys.* 10. *pp.* 91–102, *March*, 1936.—The rectifying property is observed generally to decrease with the rise of temperature, as has also been recorded by previous observers.

In the case of the iron pyrites crystal, which is studied in detail, two types of rectifying point are found. In the case of the first type the diminution in rectification with increase of temperature is due to a greater rate of increase in conductivity in the high-resistance direction than in the low-resistance direction, while in the case of the second type it is due to an increase in conductivity in the high-resistance direction and a decrease in the low-resistance direction. Good rectifying points are found on the surface of the crystal even at 270° C., contrary to the results reported by Khastgir and Das Gupta [see Abstract 2693 (1935)] according to whom the rectification disappears completely at 100° C. The effect of u.v. light on the rectification is very feeble; in some cases the rectification increases and in other cases it diminishes. AUTHOR.

2832. Surface Conductivity of Cuprous Oxide. L. Dubar. *Comptes Rendus*, 202. *pp*. 1330–1332, *April* 15, 1936.—Continuing previous work [see Abstract 295 (1936)] the conductivity of surfaces degassed under the action of heat in a vacuum, and fresh surfaces obtained by rupture in a vacuum, is measured. The apparatus and method are briefly described. In the temperature range 17°–230° C. the internal conductivity varies exponentially with temperature [$3 \cdot 17 \times 10^{-9}$ mho./cm. at 22°; $2 \cdot 08 \times 10^{-5}$ mho./cm. at 227° C.]. Under the action of prolonged degassing the surface conductivity becomes negligible. The conductivity of freshly made surfaces is also inappreciable. The conductivity at 22° C. before degassing is $7 \cdot 8 \times 10^{-8}$, and after degassing of the order of magnitude of the experimental errors. The high values of the conductivity before degassing are due to contamination of the surface by adsorption. C. J. B. C.

2833. Electrostatic Behaviour of Supraconductors. H. London. *Roy. Soc., Proc.* 155*A*. *pp*. 102–110, *May* 18, 1936.—The question, whether, in a supraconductor, the lines of electric induction terminate discontinuously in surface charges or whether they penetrate a thin layer of the supraconductor was undecided. It is decided experimentally in favour of the surface charges by the measurement of the capacity of a supraconducting condenser. Accordingly $E = 0$ is valid in stationary conditions even in surface regions of the order of magnitude of 10^{-7} cm. The measurements are carried out with a very low measuring voltage in order to exclude disturbance of supraconductivity due to a possible electric threshold value. AUTHOR.

2834. Transition of Hexagonal α-$\rightleftharpoons$ Cubic β-Titanium. J. H. de Boer, W. G. Burgers and J. D. Fast. *K. Akad. Amsterdam, Proc.* 39. 4. *pp*. 515–519, 1936.—The resistivity-temperature curve for ordinary Ti shows a peak but no evidence of lattice transformations. For a freshly-prepared rod which has been allowed to *grow* over the measuring contacts and is never removed from the preparation tube, a sharp drop in resistance occurs at 882 ± 20° C. O_2 and N_2 cause rounding of the corner and hysteresis, respectively. By the Debye-Scherrer method, β-titanium is found to be body centred cubic, $a = 3 \cdot 32$ Å at 900° C.
D. R. H.

2835. Resistivity of Dilute Solid Solutions. N. F. Mott. *Cambridge Phil. Soc., Proc.* 32. *pp*. 281–290, *May*, 1936.—For long wavelengths $\pi mc^2(1 - n^2 + k^2)/e^2 \lambda^2$ lies between $0 \cdot 8$ and $0 \cdot 9$ for Au and Ag, and this close approach to unity shows that the electrons behave almost as though free. The value of $0 \cdot 4$ (lower for newly polished surfaces) shows that they are more tightly bound in Cu. For free electrons

$\rho = \cdot 81 \quad mv\,x\pi\,a^2(E_0 - E_0')^2/e^2E^2_{max}$, where $E_{max} = mv^2/2$, *i.e.*, the K.E. at the surface of the Fermi distribution. For 1 % Au in Ag or 1 % Ag in Au, $\Delta\rho = 0 \cdot 38$, in direct agreement with experiment. Values of $E_0 - E_0'$, taking into account interchanges between valency electrons and inner shells, agree qualitatively with experimentally deduced values. With uniformily distributed positive charge, the stranger atom merely having an extra charge of ze at its centre, one obtains for the screening coefficient $1/q$, $q = (16\pi^2me^2/h^2)\ (3p/\pi)$ whence $q = 0 \cdot 58$ for Au and Ag and $0 \cdot 55$ for Cu, probably the true values of $1/q$ are rather smaller; $y = q^2h^2/4m^2v^2$ whence $y = 0 \cdot 46$ for Cu and $0 \cdot 52$ for Au and Ag. Linde finds experimentally for various elements dissolved in Ag or Au $\Delta\rho = a + bz^2$ where a is small and $b = 0 \cdot 30 - 0 \cdot 33$ microhm cm.$^{-3}$, for Cu $b = 0 \cdot 22 - 0 \cdot 28$. From the formula $\Delta\rho = z^2e^2f(y)/100\,mv^3$, $b = 5 \cdot 8\,f(y)$ for Ag or Au, $b = 4 \cdot 0\,f(y)$ for Cu. Hence $f(y) = 0 \cdot 06$ approx. implying that the screening constant $1/q$ is half the calculated value, *i.e.*, about 0·3 Å. Such an error might well result from approximations in the methods of calculation. $\Delta\rho$ is less for Cu, since the electrons in the more compact metal move faster and are consequently less scattered by the screened Coulomb field. [See Abstract 1167 (1933).] D. R. H.

2836. Electrical Resistance of Bismuth Alloys. N. Thompson. *Roy. Soc., Proc.* 155*A*. *pp*. 111–123, *May* 18, 1936.—The electrical resistance of single crystals of Bi containing small amounts of Pb, Sn, Ge, Se, Te, and other elements is measured over a temperature range from 14–400° Abs. The three first-named elements dissolve in the Bi lattice and produce an alloy which has a large negative temperature coefficient of resistance parallel to the principal axis of the crystal. Perpendicular to the axis the effect is similar but less marked. Se and Te both dissolve in Bi, thereby reducing its specific resistance, both parallel and perpendicular to the axis, except at low temperatures. There is no negative temperature coefficient. A qualitative explanation of these results is suggested on the basis of Jones's theory of Bi [see Abstract 39 (1935)]. AUTHOR.

2837. Electrical Conductivity of Vitreous Barium Borate. B. Markin and R. Müller. *Acta Physicochimica*, 4. 3. *pp*. 471–480, 1936. *In German*.—The electrical conductivity of the glass-forming systems $BaO + B_2O_3$, $Na_2O + BaO + B_2O_3$, and $ZnO + B_2O_3$ is investigated. The results indicate a movement of bivalent kations in glasses with a large content of the corresponding metal oxides. The dissociation work of the ions E = 2AR in agreement with the assumptions for Ba and Zn glasses is double that of the alkali-boric glasses; here the coefficient B has a normal value, where B is the constant in the expression for the specific conductivity given by the equation $\log \chi = -A/T + B$. The increase of the coefficient A is established for boric glasses when barium glasses are introduced into them. R. L.

2838. Normal Conduction Current and Recovery Current Effects for Solid Paraffin after Irradiation with γ-Rays. F. Seidl. *Zeits. f. Physik*, 99. 9–10. *pp*. 695–709, 1936.—Measurements *in vacuo* of the current passed by a thin layer of highly purified paraffin were made before and after irradiation from a powerful source of γ-rays (70 mg. Ra). An increase in the normal conduction current due to the irradiation of more than 10 times was observed 4 hr. after ceasing to irradiate and an increase of 6 to 9 times, 55 hr. after. Increases in the charging up current and in

the recovery current were also observed. These currents obeyed approximately the Kohlrausch formula. The specific resistance of paraffin of melting point 52° to 53° C. was found to equal $3 \cdot 3 \times 10^{18}$ ohm. cm.
W. S. S.

See also Abstracts 2504, 2576, 2671, 2853, 2876, 2900.

DIELECTRICS AND CAPACITANCE.

2839. Polarisation of the Hydrogen Halides. C. H. D. Clark. *Leeds Philosoph. & Lit. Soc., Proc.* 3. *pp.* 208–217, *April,* 1936.—The relation between the polarisation properties and the internuclear distances of the hydrogen halides is studied. An earlier suggestion of the writer, that the polarisability of a hydrogen halide is proportional to the cube of its internuclear distance, is confirmed. The polarity decreases from HF to HI. The lowering of polarisability by a proton entering a halogen ion is found to stand in linear relation with Debye's " apparent polarisability " for the four halides. Polarisation properties (dielectric constants, indices of refraction for zero frequency, dipole moments and distances, polarisabilities, deviations from additivity of internuclear distance and molecular refraction, and the total, electron and orientation polarisations) of the four members of the group are calculated and interpreted in relation to corresponding changes in structure. The general nature of the polarisation of the hydride of element No. 85 is predicted. AUTHOR.

2840. Polarisability and Internuclear Distance for Simple Di-Atoms. F. R. Goss. *Leeds Philosoph. & Lit. Soc., Proc.* 3. *pp.* 231–234, *April,* 1936.—The polarisability of simple di-atoms is found to be $kr_e^3/2$ for hydrogen, $(k - n/4)r_e^3$ for the KK period, and $(k + 0 \cdot 20 - n/4)r_e^3$ for higher periods, where k has the value $3 \cdot 85$ and n is the molecular group number. AUTHOR.

2841. Polarisability of Molecular Hydrogen H_2. C. E. Easthope. *Cambridge Phil. Soc., Proc.* 32. *pp.* 260–264, *May,* 1936.—The polarisability of H_2 is calculated using Lennard-Jones' modified form of Schrödinger's perturbation theory. The results obtained are in direct contradiction to those previously obtained by Mrowka [see Abstract 4479 (1932)] by a perturbation method and certainly show that the perturbation theory will give results at least in moderate agreement with those obtained by the variational method. AUTHOR.

2842. Dielectric Constant of a Space Containing Electrons. S. P. Prasad and M. N. Verma. *Zeits. f. Physik,* 99. 7–8. *pp.* 552–561, 1936.—The change of dielectric constant of a space with variation of concentration of electrons and with variation of wave-length of applied oscillations is determined. The space investigated is that between the screen and anode of a screened-grid valve. It was found that (1) the dielectric constant decreases with increase of concentration of electrons, and (2) decreases with increase of wave-length. In no case is an increase of dielectric constant observed, so that it never exceeded unity. The results are shown to agree with the view given by Lorentz. A. M. T.

2843. Dielectric Constants of Organic Liquids at Radio Frequencies. Part II. Chlorobenzene and Ethylene Dichloride. R. M. Davies. *Phil. Mag.* 21. *pp.* 1008–1029, *May,* 1936.—Previous work [see Abstract 836 (1936)] for the accurate determination of the dielectric constant of organic liquids is here continued, the same method being employed, and, with the exception of the condenser, the same apparatus used, with CCl_4 as the standardising liquid. The object of the work was to obtain secondary-standard liquids to cover the range of dielectric constant which extends from about 2 for benzene to about 80 for water, and the substances chosen were monochlorobenzene and ethylene dichloride. The final mean values given by the alternative use of parallel-plate condensers and cylindrical condensers were :

For monochlorobenzene : At 20·0°C., $\epsilon_{20} = 5{\cdot}713_5$. $d\epsilon/d\theta = -0{\cdot}017_4$.
At 25·0° C., $\epsilon_{25} = 5{\cdot}626_3$.
For ethylenedichloride : At 20·0°C., $\epsilon_{20} = 10{\cdot}64_7$. $d\epsilon/d\theta = -0{\cdot}057_9$.
At 25·0°C., $\epsilon_{25} = 10{\cdot}35_8$.

Exceptionally full experimental details are included, and a comprehensive discussion of the results is given together with a comparison of those obtained by previous investigators. H. H. Ho.

2844. Electric Moments of Chlorinated Naphthalenes. G. C. Hampson and A. Weissberger. *Chem. Soc., J. pp.* 393–398, *March,* 1936.—In this continuation of previous work [see Abstract 4318 (1934)] it is found that each C-Cl bond in the chloronaphthalenes is directed as from the centre of the ring and that Cl in the β position gives a value for the C-Cl moment practically the same as in chlorobenzene. In the α position the moment is less, indicating a greater mesomeric effect into the ring. Two mono- and eight di-chlorimated naphthalenes are investigated. W. R. A.

2845. Dipole Moment and Structure of Ethylenic Compounds. E. Bergmann. *Chem. Soc., J. pp.* 402–411, *April,* 1936.—Data are recorded and discussed for 35 ethylenic compounds and for 12 related substances. W. R. A.

2846. Apparent Dipole Moments of Benzene, *p*-Dichlorobenzene, Diphenyl, 4 : 4′-Dichlorodiphenyl, and Carbon Disulphide in Polar Solvents. Catherine G. le Fèvre and R. J. W. le Fèvre. *Chem. Soc., J. pp.* 487–491, *April,* 1936.—These substances become apparently polar on solution in the various polar solvents used ; the degree of apparent polarity is roughly proportional to the moment of the solvent. The significance of these observations is discussed in the light of previous work. W. R. A.

2847. Solvent Effect in Dipole-Moment Measurements. Polarisations of Chloro- and Nitrobenzene, Chloroform, and Bromoform in a Series of Polar Solvents. R. J. W. le Fèvre and P. Russell. *Chem. Soc., J. pp.* 491–495, *April,* 1936.—These four substances, two of which have positive Kerr constants and the other two have negative Kerr constants, have been examined to test existing theories of solvent effect. W. R. A.

2848. Apparent Dipole Moment of Paraldehyde in Various Solvents. R. J. W. le Fèvre and P. Russell. *Chem. Soc. J., pp.* 496–497, *April,* 1936.—Data for paraldehyde in 9 different solvents are recorded. W. R. A.

2849. Absorption Changes with Field-Strength of Weak H.F. Fields in Certain Substances. E. K. Savojskij and B. M. Kosyrev. *Comptes Rendes* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 3. *pp.* 109–113 *and* 1. 5. *pp.* 219–220, 1936. *In German.*—The present accepted models of dipole liquids and ionised solutions do not include the possibility of a relation of absorption of weak electrical fields to field intensity. This is studied for the case of acetic acid, both liquid and solid. The absorption is found to be a very complex function of the field strength. Measurements are made by means of a Lecher wire system containing the test condenser, the oscillations being produced by an ultra-short wave generator. The grid current against voltage of the output valve is determined as a measure of absorption. Curves of I_g against the applied voltage give a number of maxima when the substance is employed as dielectric in the test condenser. Several confirmatory tests are made. The critical values of voltage are independent of temperature or state. Similar results are also found for sodium acetate. It is concluded that the effect is due to an intramolecular process and the study will be extended to determine the effect of frequency and to non-aqueous solutions and other compounds of acetic acid. A. M. T.

See also Abstracts **2504, 2833, 2853.**

ELECTROCHEMISTRY.

2850. Second Dissociation Constant of Carbonic Acid. Y. Kauko and V. Mantere. *Zeits. f. phys. Chem.* 176. *Abt.A*.3. *pp*. 187–201, 1936.—The author considers the second dissociation constant of H_2CO_3 as dependent upon the pH scale used by some observers and upon the use by them of too high a concentration of the solution, so that extrapolation to infinite dilution is not always possible, and hence the different values recorded in the literature. For these reasons, the author carries out measurements between the concentrations of 10^{-4} to 10^{-3} M, and carries out the extrapolation by means of the Debye-Hückel theory. The values obtained for the second dissociation constant of H_2CO_3 are :—

0°	12·5°	18·°	25·°	37°· C.
$2{\cdot}57\times10^{-11}$	$4{\cdot}70\times10^{-11}$	$5{\cdot}16\times10^{-11}$	$5{\cdot}70\times10^{-11}$	$7{\cdot}15\times10^{-11}$?

The accuracy of the measurements is ± 7 %. F. J. B.

2851. Dissociation Constant of Hydrochloric Acid. R. A. Robinson. *Faraday Soc., Trans.* 32. *pp.* 743–744, *May,* 1936.—The calculation of the dissociation constant of HCl from partial vapour pressure data is extended to a wider range of concentration and temperature. The thermal changes associated with the complete process of dissociation of HCl are found to be 17,900 cal. (evolved). AUTHOR.

2852. Transport Numbers of Paraffin-Chain Salts in Aqueous Solution. G. S. Hartley, B. Collie and C. S. Samis. *Faraday Soc., Trans.* 32. *pp.* 795–814, *May,* 1936.—Transport number and conductivity measurements on cetylpyridinium and cetyltrimethylammonium bromides are described. The equivalent conductivity is found to fall very steeply at a concentration about $N/1000$, the transport number rising rapidly in the same region and reaching values greater than unity at concentrations well below $N/100$. This means that the Br transport numbers are negative, *i.e.*, more Br is carried towards the kathode by more-than-univalent kations than is migrating in the free state to the anode, which admits of no other explanation than the formation of multiple kations (micelles). The equivalent conductivity of the organic radical rises much above its infinite dilution value, which gives the directest possible evidence of aggregation. The fall of the total conductivity in this range of concentration is due to the enormous reduction of the conductivity of the Br ions consequent on their attachment to micelles. A number of relationships between conductivities in a solution containing are established. Calculations are given to show how considerations of " atmosphere " effects can influence quantitative arguments, and to show that a simple picture of these solutions derived from consideration of the causes underlying their peculiar behaviour is probably quite adequate to explain all the measured properties. C. J. B. C.

2853. Growth and Structure of Electrolytic Aluminium Oxide Layers. T. Rummel. *Zeits. f. Physik,* 99. 7–8. *pp.* 518–551, 1936.—The conditions for the formation of various types of electrolytic aluminium oxide layers of thicknesses exceeding 1μ are investigated with special reference to their application as electrical insulating layers in the dry state. A process is developed for the production of non-corrosive insulating layers of high quality. The dielectric properties are found to be dependent to a high degree on the content of combined water (hydroxide) in the layer. The thicker layers are produced in the locality of the maximum energy development. Special tests on corona phenomena and blocking effect suggest the construction of a model layer on which the latter is experimentally simulated. A. M. T.

2854. Protective Layer on Aluminium. W. J. Müller. *Zeits. f. Elektrochem.* 42. *pp.* 166–175, *April,* 1936.—The behaviour of extremely pure Al (99·998 %) is studied in a saturated solution of sodium bicarbonate, at low voltages. The formation of the film takes place considerably more rapidly than with Al of commercial purity. The residual currents are also smaller. Below an applied potential of 2 V the passage of current in anodic and kathodic directions is practically the same, but at about 2 V the passage of current in the kathodic direction first led to a passage of current several hundred times greater. The behaviour of the formed valve electrodes is found to be in entire harmony with the consequences of the electroosmotic theory. F. J. B.

2855. E.M.F. of Movement of Metals in Water. S. Procopiu. *Comptes Rendus,* 202. *pp.* 1371–1373, *April* 20, 1936.—Two electrodes of the same metal are placed one in each of two similar vessels containing water and connected by a siphon. The moving electrode is rotated by a motor having a speed up to 3000 r.p.m. The e.m.f. of movement of metals, negative for Ag and Cu, positive for Pb, Ni, Fe, Al, Zn, has a definite value for a freshly made cell but this value decreases with time. Exceptions are Pb and Zn for which the e.m.f. increases. As the speed of the electrode increases the e.m.f. also increases, tending to a limiting value for high speeds. For electrodes immersed in sugar solution no time variation is observed, probably because the metal is protected from oxidation ; also the e.m.f. is less than for water, possibly attributable to the lower dielectric constant. The change of e.m.f. with speed may be explained by the existence of a layer of liquid adhering to the metal, and only detached by high centrifugal forces. A second layer of liquid of different H-ion concentration from the rest of the liquid is supposed, which is removed by slow speeds of rotation giving rise to the e.m.f. of movement. **Erratum,** *Ibid.,* 202. *p.* 1880, *June* 2, 1936. C. J. B. C.

2856. Normal Potential of Metals and Henry Constant of Ions. I. Uhara. *Phil. Mag.* 21. *pp.* 958–976, *May,* 1936.—The Henry constant is thus defined : The equilibrium vapour pressure of an ion, present in concentration c' in solution, is given by c'/k, where k is Henry's constant. Expressions for the normal potentials of metals in solution are derived thermodynamically. Values of the normal potentials calculated from heats of formation and solubility of slightly soluble metallic compounds agree fairly well in some cases with values already given in the literature. Parallelism is found between values of the Henry constant and the heat of hydration of the respective ions. J. S. G. T.

2857. Hydrogen Overvoltage in Non-Aqueous Solutions. Part I. S. Lewina and M. Silberfarb. *Acta Physicochimica*, 4. 2. *pp*. 275–282, 1936. *In German.*—The hydrogen overvoltage on a Hg electrode is measured in ethyl alcohol solutions of HCl. The acid was 0·01 and 0·54 *N*, and the current density was 10^{-6} and 10^{-2} A per cm^2. The results show that the overvoltage is independent of the concentration of the acid within the range of the experiments. It is found to be smaller than in water solutions. F. J. B.

***2858. pH Conversion Chart. W. H. Goss.** *Washington Acad. Sci., J.* 26. *pp*. 150–156, *April* 15, 1936.—A conveniently arranged chart for converting e.m.f. values to pH is given. The chart is available for use with readings taken with hydrogen, glass or quinhydrone electrodes and with 0·1 *N*, or saturated KCl–HgCl reference standard electrodes. The accuracy attainable with a graph 14 × 18 in. enlargement is ± 0·02 pH unit. F. J. B.

See also Abstract 2698.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

2859. Creation of Electron Pairs by Collision of Particles. G. Racah. *N. Cimento*, 13. *pp*. 66–73, *Feb*., 1936.—Continuing previous theoretical work on this subject [see Abstract 4698 (1934)], the effective cross-sections for the creation of electron pairs in collision processes are calculated. The paper is entirely mathematical. C. J. B. C.

2860. Theory of the Positron. A. Proca. *Comptes Rendus*, 202. *pp*. 1366–1368, *April* 20, 1936.—Eight necessary conditions to be satisfied by a theory of the positron are briefly referred to in connection with the theories suggested by Pauli and Weisskopf [see Abstract 4872 (1934)] and by Gordon. J. S. G. T.

2861. Measurement of e/m with a Triode Valve. S. Ram. *Indian Journ. Phys.* 10. *pp*. 127–132, *March*, 1936.—The effect of a magnetic field on the grid current of a triode valve is investigated and a method devised for the determination of *e/m* with the help of two formulæ which are similar to that used by Hull for the determination of the magnetic field with the help of a magnetron. The mean value of *e/m* obtained with one formula is $1{\cdot}77 \times 10^7$ and with the other it is $1{\cdot}79 \times 10^7$. AUTHOR.

2862. Origin of Mass in Neutrons and Protons. M. N. Saha. *Indian Journ. Phys.* 10. *pp*. 141–153, *March*, 1936.—A general survey-review is given of the following topics: mass, velocity, and momentum in relativity, and the electromagnetic origin of mass; theory of rotating electrons; identity of mass and energy; mass of the electron, proton, and neutron; free magnetic poles and their mass; identification of magnetic dipoles with the neutron considered with the help of the Dirac equations for free magnetic poles; a review of attempts to explain the proton-electron mass ratio. N. M. B.

2863. Production of Intense Beams of Slow Electrons. R. Planiol. *Comptes Rendus*, 202. *pp*. 1267–1268, *April* 6, 1936.—A method of obtaining an intense beam of electrons using a low accelerating potential is described. It consists of an approximately uniform magnetic field having the same direction as that of the electrons; two grids are mounted close to an emitting filament, the nearer grid being maintained at two relatively high positive potential with respect to the second grid which is about

15 cm. distant from the plate at the same potential as the second grid. An intense approximately parallel beam is obtained between the second grid and the plate. A typical result is as follows: total filament current 220 mA., first grid potential + 700 V, second grid potential + 70 V, plate potential + 70 V. H. J. H. S.

2864. Diffraction Effects of Slow Electrons. H. E. Farnsworth. *Phys. Rev.* 49. *pp.* 598–605, *April* 15, 1936.—The structure of the diffraction beams corresponding to Bragg reflections from a (210) and a (520) set of planes for (100) and (110) boundary planes of a silver single crystal is examined. For the second-order beam from the (210) planes at about 200 V, and the first-order beam from the (520) planes at about 300 V, the changes in fine-structure characteristics due to a change in the surface atomic layer of the amount indicated are small compared to the differences in fine-structure characteristics of the beams from different sets of atomic planes. Dependence of beam structure on the direction of the diffracted beam in the crystal is examined and deviations from the surface grating formula indicate the presence of directional effects. A sensitive method of observation for determining what crystal facets are present is described. F. C. C.

2865. Penetration of Slow Diffracted Electrons. H. E. Farnsworth. *Phys. Rev.* 49. *pp.* 605–609, *April* 15, 1936.—A known number of atomic layers of one metal is deposited on the surface of a single crystal of another metal by evaporation in a high vacuum. Electron diffraction shows that a silver film having a thickness up to 15 atoms does not form in a single crystal when deposited on the (100) face of a copper crystal. A monatomic layer reduces the maxima of the beams from the copper lattice by at least 70 % for energies up to 300 eV. A silver film forms in a single crystal when deposited on the (100) face of a gold crystal. At least 50 % of the maximum of each diffraction beam from a thick silver crystal is contributed by the surface atomic layer of silver for energies as high as 300 eV. while at least 90 % is contributed by a surface layer 2 atoms thick. A possible selective effect is observed for l.v. reflection from a film 2 atoms thick. F. C. C.

2866. Electronic Analysis: Effect of Prolonged Action of Electron Beam on Thin Films. J. J. Trillat and S. Oketani. *Comptes Rendus*, 202. *pp.* 1332–1334, *April* 15, 1936.—Prolonged exposure to a beam of electrons of a metal film (*e.g.*, Au) causes the diffraction pattern, which had at first become sharper through removal of the fatty film [see Abstract 5212 (1935)] then gradually (after 1·5–2 hr.) to disappear. This disappearance, which is permanent, is due to local heating by the electrons, which, though not causing actual fusion, produces local increase in thickness by liquefaction or flow of the surface layer [see Abstract 3265 (1935)]. In preparing electron diffraction diagrams care must therefore be taken to avoid prolonged exposure as far as possible. C. A. S.

2867. Shot Effect of Secondary Emission. Part II. M. Ziegler. *Physica*, 3. *pp.* 307–316, *May*, 1936.—In a previous paper [see Abstract 1853 (1936)] the fluctuations of a current of secondary electrons were calculated on the assumption that primary impact and secondary electron emission are practically simultaneous. From this theory it can be shown that a certain number of primary electrons should each cause the emission of at least n_K secondary electrons, n_K being the smallest whole number greater than χ, the coefficient of secondary current fluctuation. The distribution curve should therefore extend further than $n = n_k$ and it can be shown that it has no pronounced maximum for any value of n greater than 0. If δ is the coefficient of secondary emission $(= \bar{I}_{sec.}/\bar{I}_{prim.})$ the quotient δ/χ gives an idea of the percentage of active primary electrons and represents the "quality" of multiplication by secondary emission, with regard to fluctuation noise. A diagram is given showing the variation of δ, χ and δ/χ with the velocity of the primary electrons for a nickel plate coated with an active layer of BaO and SrO. A. W.

***2868. Applied Electron Optics. V. K. Zworykin and G. A. Morton.** *J.O.S.A.* 26. *pp.* 181–189, *April*, 1936.—An account is given of certain practical details concerning the formation of electron images, chiefly by means of electrostatic fields. The use of an electron lens as a simple means of forming an image of an emitter is illustrated by a description of two important practical applications—the electron gun and the electron microscope. The problem of producing an electron image of an extended object is then discussed theoretically. In practice, a photosensitive kathode is used from which electrons are released in proportion to the intensity of the incident light (a projected image); the electrons are focussed by means of an electrostatic lens comprising two cylinders. The nature and origin of the image distortion in such a system are discussed and methods of overcoming it are described. Photosensitive kathodes which respond to infra-red radiation may be prepared and a number of infra-red photomicrographs are reproduced; these are obtained by projecting infra-red images on to the sensitive kathode which gives rise, by electron-optical means, to visual images on a fluorescent screen. An infra-red telescope is also described. [See following Abstract.] H. J. H. S.

***2869. Electron Optics and its Applications. V. K. Zworykin.** *Onde Élec.* 15. *pp.* 265–298, *May*, 1936.—The author reviews the principles of electron optics, and describes the simpler tubes, and methods of overcoming image distortion therein. Application to television, electron microscopy and vision through haze are described. The "electron multiplier" is also described (types using electric or electric and magnetic fields for concentration). Compared with a multi-stage thermionic amplifier for photoelectric currents, such a multiplier has a similar figure of merit (mA/W), a better signal/noise ratio (by up to 200 times), uniform frequency response and great compactness. [See preceding Abstract.] R. M.

2870. Models of Electric and Magnetic Fields in Electron Optics. E. Brüche and A. Recknagel. *Zeits. f. techn. Physik*, 17. 4. *pp.* 126–134, 1936.—A gravitational model which illustrates the action of electromagnetic fields on the electron is discussed and it is shown that rolling spheres in flat gravitational potential fields describe the same paths as electrons in similar electromagnetic fields. Models are then described of a number of important electron optical cases; amongst these are those of a negatively charged ring acting as an *Einzellinse*, of an "immersion lens" and of a cylindrical condenser. Models to illustrate focusing in magnetic and in alternating fields are also described. H. J. H. S.

2871. Concentration of Electron Beams by Gases. I. Sokolskaya. *Techn. Phys., U.S.S.R.* 3. 1. *pp.* 28–38, 1936. *In English.*—Experimental results show that gas concentration of electron beams is more complicated than would appear from Johnson's theory. It seems that these complications arise from the fact that the character of the focusing depends on the electron optics of the focusing system and on the presence of a discharge in the surrounding gas. The latter factor is considered. Relations between focal-length and gas pressure, beam current and velocity for a gas-focused beam in A under different conditions are determined experimentally. Discharge effects connected with gas-focusing and the effect of wall potential on focusing are described. The mechanism of the physical processes involved in gas-focusing are discussed and their bearing on the use of electron tubes in practice is mentioned. H. J. H. S.

*2872. **New Electron Tubes and New Uses. D. Ulrey.** *Physics,* 7. *pp.* 97–105, *March,* 1936.—Discusses the various electron tubes and their industrial uses. Among the tubes treated are (*a*) X-ray tubes, referring particularly to their uses in bringing about biological mutations, (*b*) kathode-ray tubes, mentioning specially the kathode-ray oscillograph, (*c*) photo-tubes applied to the automatic control of machinery, (*d*) h.f. oscillators, with reference to the biological effects of h.f. radiation and (*e*) the newer gas triodes, and their more recent developments in the "ignitron," which can pass currents up to 2000 A, and are used in the welding industry. G. E. B.

*2873. **Action of Electron Multipliers. W. Henneberg, R. Orthuber and E. Steudel.** *Zeits. f. techn. Physik,* 17. 4. *pp.* 115–120, 1936.—The authors investigate the action of the electron multiplier due to Farnsworth and base their experiments on a simple model consisting of a tube enclosing two plates across which an alternating voltage is connected; the movement of the electrons is investigated, the escape velocity being initially neglected. Although the plates should be separated by a distance which is traversed by the electrons in half a period, it is shown that electrons which emerge with a phase delay up to 65° may gradually be brought into phase and particpate in the multiplying action. The paper concludes with a brief discussion of the influence of escape velocity.
E. T. A. R.

See also Abstracts 2486, 2489, 2503, 2561, 2709, 2764.

ELECTROSTATICS.

2874. Contact Potential Measurement. H. Gericke. *Phys. Zeits.* 37. *pp.* 327–338, *May* 1, 1936.—Short descriptions are given of the methods used in determining the contact potentials of two metals. Advantages and disadvantages are discussed in the use of ionisation, condenser, photoelectric or thermionic methods. It is pointed out that Zn is negative to Cu for ionisation and positive for all other methods, this is shown to be due to measurement of p.d. between the metals in the former case and between the external double layer in the latter cases. It is pointed out that since the thermionic work function and the photoelectric frequency limits have not yet been very accurately found, results using these methods are not reliable. H. M. B.

*2875. **Measurement and Production of High Potentials. M. Pauthenier and Marguerite Moreau-Hanot.** *Comptes Rendus,* 202. *pp.* 929–930, *March* 16, 1936.—A method of measuring the potential to which a sphere is charged is described, which consists in placing on the upper pole a thin metallic disc curved so as to fit the sphere. For a given potential depending on the mass of the disc, the electrostatic force of repulsion will equal the weight and the disc will be repelled from the sphere and fall off. A series of such discs of graduated weights will provide a means of measuring an extended scale of potentials. The problem of loss of charge to surrounding objects due to concentration of the field caused by surfaces of short radius of curvature and consequent brush discharge is also discussed. F. S. B.

***2876. Theory of Electrometer Design. W. W. Hansen.** *Rev. Sci. Instruments,* 7. *pp.* 182–191, *April,* 1936.—Zero-instability sets a limit to the sensitivity of electrometers of all types, the theoretical limit being set by Brownian movements of the system. External electromagnetic disturbances are more serious with thermionic than with purely electrostatic instruments owing to the non-linearity of their characteristics, and screens of symmetrical construction are advised. The general theory developed for purely electrostatic instruments, together with practical desiderata, determine the following features of a design, which satisfies theoretical and practical requirements: a needle literally like a needle, observed by a microscope; fixed electrodes of special shape symmetrically arranged; separate auxiliary electrodes for electrostatic control of sensitivity. The theoretical limit should be reached without extreme refinement of construction with a quarter-period of 15 sec. L. H.

See also Abstracts 2651, 2833, 2914.

MAGNETISM AND ELECTROMAGNETISM.

2877. Electromagnetic Equations and the Equivalence of Energy and Mass. J. Urbanek. *J. de Physique et le Radium,* 7. *pp.* 158–162, *April,* 1936.—The form of physical equations and the rôle of factors of proportionality are considered, and the variations which the electromagnetic equations undergo when the number of fundamental dimensions varies from 5 to 2. The latter case corresponds to the equivalence of mass and energy. It is shown that this leads to a system of equations of maximum symmetry, and this independent of the dimensions of the magnetic permeability and the dielectric constant. The system involves only two fundamental dimensions. Finally, a relativistic system of units based on these two fundamental dimensions is given. C. J. B. C.

2878. Magnetic and Electrostatic Energy. E. A. Guggenheim. *Roy. Soc., Proc.* 155*A*. *pp.* 49–70, *May* 18, 1936.—The usual well-known formulæ for magnetic and electrostatic energy involve the assumption that the permeability and the dielectric coefficient are independent of the field strength. Supposing this assumption to be valid under isothermal conditions, it will usually not be valid under adiabatic conditions. Similarly it will usually not be simultaneously valid for variations at constant volume and variations at constant pressure. For an exact development of the thermodynamics of magnetic and electrostatic systems it is important to have formulæ independent of this assumption. Proceeding from Maxwell's equations, formulæ for the Lagrangian and Hamiltonian functions are derived which are independent of the relationship between the magnetic field and the magnetic induction and of that between the electric field and the electric displacement. The relationship between these formulæ of general validity and other better known formulæ of restricted validity is discussed. [See following Abstract.] AUTHOR.

2879. Thermodynamics of Magnetisation. E. A. Guggenheim. *Roy. Soc., Proc.* 155*A*. *pp.* 70–101, *May* 18, 1936.—Proceeding from a formula for magnetic energy [see preceding Abstract] and of general validity for systems containing currents, permanent magnetism, and induced magnetism, all the more important thermodynamic formulæ for magnetic systems are derived. A general form is derived for the magnetic equation of state, on which magnetic thermometry ultimately depends. A discussion of adiabatic changes of magnetisation is included. Where the present treatment especially leads to results differing from those of previous less exact treatments is in systems maintained at constant pressure. The accurate formulæ applicable to these conditions turn out to be more complicated than previously supposed. Fortunately magnetostriction is usually so small that in practice it is ignored. One may then use for variations at constant pressure the simpler formulæ strictly valid only for variations at fixed configuration. AUTHOR.

2880. Change of Thermal Energy Due to Magnetisation in Ferromagnetic Substances. T. Okamura. *Tôhoku Univ., Sci. Reports,* 24. *pp.* 745–807, *Feb.,* 1936. *In English.*—The absorption or evolution of heat during the process of magnetisation in Fe, Ni, Co, steel, K.S. magnet steel, Ni-Fe alloy (35 % Ni) and single crystals of Fe is measured by means of a sensitive thermocouple system by which changes of the order of 10^{-6}° C. may be recorded. There are 2 types of thermal change, reversible and irreversible—the former is the magneto-caloric effect and the latter is due to magnetic hysteresis. They may be termed the reversible and irreversible magnetocaloric effects. During initial magnetisation, the irreversible thermal curves are similar to each other and have a form closely related to that of the magnetisation curve. The reversible thermal curves, when plotted against field are similar in the case of Fe, steel, K.S. magnet steel, Ni and Ni-Fe. For cyclic magnetisation, starting from a maximum field, no irreversible thermal change is observed on decreasing the field but it becomes apparent as the field approaches zero and, when the field is reversed at that point, thermal evolution becomes appreciable ultimately reaching a saturation value. Armco Fe, steel, Ni and K.S. magnet steel have 1 maximum and 2 minima symmetrically distributed with respect to the ordinate axis. In Co the intermediate maximum only is observed and in the Ni-Fe alloy the maximum disappears. According to the Honda-Ôkubo theory of ferromagnetism, the irreversible heat is the kinetic energy acquired by molecules during their abrupt rotations and may hence be calculated from magnetic data. The reversible thermal changes may be satisfactorily explained on thermodynamical principles. H. J. H. S.

2881. Influence of Thermal Variation of the Molecular Field on the Curie Constant. L. Néel. *Comptes Rendus,* 202. *pp.* 1038–1040, *March* 23, 1936.—The effect is discussed for Co and Ni. W. R. A.

2882. Attempt to Interpret the Moment at Saturation of Ferromagnetic Substances. L. Néel. *Comptes Rendus,* 202. *pp.* 1269–1272, *April* 6, 1936.—A formula is derived for the mean magnetic moment of ferromagnetics and the values calculated from it are in very good agreement with the experimental values for Fe, Co and Ni. W. R. A.

2883. Magnetic Susceptibility of Di-substituted Benzene Derivatives. K. Kido. *Tôhoku Univ., Sci. Reports,* 24. *pp.* 701–706, *Feb.,* 1936. *In English. Report No.* 359 *of Research Inst. for Iron, Steel and Other Metals.*—By the method of horizontal displacement of a specimen in a heterogeneous field, the magnetic susceptibility of di-substituted benzene derivatives is measured. The observed values of the molecular susceptibility of these isomers, *i.e.,* ortho, meta, and para forms, are compared with the values calculated by the additive law, and Brown and Gibson's rule of substitution is in accordance with results obtained by measuring the molecular susceptibility of the compound. [See Abstract 841 (1934).] AUTHOR.

2884. Magnetic Susceptibility of Chlorine Hexoxide. J. Farquharson, C. F. Goodeve and F. D. Richardson. *Faraday Soc., Trans.* 32. *pp.* 790–795, *May*, 1936.—The susceptibility of chlorine hexoxide is measured over a temperature range − 40° to + 10° C. The density and coefficient of cubical expansion are also determined. On the basis of theoretical values for the susceptibilities of Cl_2O_6 and ClO_3 the percentage of ClO_3 present in the mixture at various temperatures is calculated, together with the corresponding equilibrium constants. An approximate value for the heat of dissociation is determined from these constants. AUTHORS.

2885. Effect of Polymerisation on Magnetic Susceptibility. S. S. Bhatnagar, M. B. Nevgi and R. N. Mathur. *Zeits. f. Physik*, 100. 1–2. *pp.* 141–144, 1936.—The susceptibilities of some groups of true and condensed polymers were measured and in all cases the value for the polymer is less than that for the original substance, *e.g.*, $-\chi \times 10^6$ for anthracene is 0·726, and for dianthracene 0·574. The results support Pascal's observations. G. E. A.

2886. Temperature Variation of Electron Spin Paramagnetism. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 191–199, *April*, 1936.—Extending previous calculations [see Abstract 330 (1936)], expressions are derived which enable the temperature variation of the paramagnetic susceptibility due to electron spin to be determined for the whole temperature range. The treatment applies to collective electrons in unfilled electron energy bands in which there is a normal energy distribution of states; free electrons are included as a special case. The range of validity of these expressions is considered, and it is shown that with their aid it is possible to determine the variation of susceptibility not only at low and high temperatures but also by interpolation in the intermediate temperature range with a probable accuracy of within 1 %. The numerical results are given in a table, and shown in a diagram. The bearing of the results in connection with the magnetic properties of metals is indicated. Certain coefficients required in applications of Fermi-Dirac statistics are evaluated. AUTHOR.

2887. Collective Electron Specific Heat and Spin Paramagnetism in Metals. E. C. Stoner. *Roy. Soc., Proc.* 154*A*. *pp.* 656–678, *May* 1, 1936.—Expressions for the spin susceptibility and electronic specific heat, and for the relation between them, are given. A method for determining the character of the effect of interchange interaction is developed. The magnetic properties of the elements in the first two columns of the periodic table, and of the transition elements and the rare earths are briefly considered, as well as the specific heat of Ni and Pt. W. R. A.

2888. Paramagnetism as a Test for Free Radicals. F. L. Allen and S. Sugden. *Chem. Soc. J. pp.* 440–441, *April*, 1936.—The magnetic susceptibilities of a number of organic substances are determined, three of them exhibiting large paramagnetism in the solid state. Solid *αα*-diphenyl-*β*-trinitrophenylhydrazyl contains at least 90 % of free radical form, and similar results are obtained with $(p\text{-}NO_2\cdot C_6H_4)_3C$– and with Ph_2C–O–K. The magnetic test is shown not to be decisive for biradicals. [See also Abstract 876 (1934).] C. B. A.

2889. Anomalous Magnetic Viscosity. Alexandra Mitkevitch. *J. de Physique et le Radium*, 7. *pp*. 133–137, *March*, 1936.—It is known from the researches of Ewing that there is a time-lag in the variation of magnetic induction with reference to the change of the field, in consequence of normal magnetic viscosity. The author's experiments prove the existence under certain special conditions of anomalous magnetic viscosity, the supplementary change of magnetic induction being of inverse sign with regard to the preceding change of magnetic force, that is to say, inverse to what could be attributed to normal viscosity, or to Foucault currents. It is also shown that in the cases where the normal viscosity can entirely mask the anomalous, by having recourse to special conditions the coexistence of normal and anomalous effects can be demonstrated.

J. J. S.

2890. Variation of Young's Modulus with Magnetisation and Temperature in Nickel. S. Siegel and S. L. Quimby. *Phys. Rev.* 49. *pp*. 663–670, *May* 1, 1936.—The % increase in Young's modulus E for annealed polycrystalline nickel, 99·7 % pure, is proportional to J^2 (J = intensity of magnetisation) between zero and about 0·4 saturation, at all temperatures below 311°. The total increase in E from the demagnetised to the saturated state is 6·7 % at 23°, reaching a maximum of 18·7 % at 185°, and decreasing to zero at the Curie point. Results are in general agreement with Akulov's theory [see Abstract 5465 (1933)]. The experimental method yields a measure of the coefficient of internal friction; the internal friction decreases with increasing magnetisation at all temperatures below the Curie point. In the demagnetised material it reaches a maximum at the same temperature as does the change in elastic modulus. Its value at magnetic saturation is the same order of magnitude as that of a non-ferromagnetic substance. N. M. B.

***2891. Magnetisation of Nickel, Permalloy and Nickel Single Crystals in High Fields. G. Gerloff.** *Zeits. f. Physik*, 99. 9–10. *pp*. 585–594, 1936.—An apparatus is described for the measurement of magnetic susceptibilities in high fields. It is shown that the susceptibility of Ni, permalloy and Ni single crystals in the annealed condition falls rapidly up to 3000 G. and attains a constant limiting value at 4000 G.; this value alters by less than 6 % for Ni and permalloy in fields up to 5500 G. and for Ni single crystals by less than 10 % in fields up to 5000 G. The value for the limiting volume susceptibility of Ni ($1\cdot5 \times 10^{-4} \pm 4$ %) is in good agreement with the results of Weiss and Forrer. For permalloy the value is $2\cdot2 \times 10^{-4} \pm 4$ %. Theoretical explanations of these results are briefly investigated. H. J. H. S.

See also Abstracts 2548, 2549, 2702, 2709, 2710, 2903.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2892. A.C. Resistance of the Human Body and its Dependence on Current. N. N. Malov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 5. *pp*. 227–230, 1936. *In German*.—It has been shown that the resistance of the human body to oscillatory currents is equivalent to that of a circuit containing ohmic resistance r_0 and capacity k_0. Experiments with various types of electrode show that this total impedance of the body can be again divided into internal impedance ($r_i k_i$) and surface impedance ($r_a k_a$). Measurements of the total impedance, and of r_0, r_i, k_0, k_i, have been made using a kathode-ray oscillograph system.

Results are given over a frequency range from 5 to 5 × 10^5 ∼. It is shown that at low frequencies the values obtained depend to a considerable extent on the value of the current; the total impedance and ohmic resistance increasing with decreasing current, and the capacity decreasing. An ionisation theory is put forward to explain these results. J. E. R.

2893. Electrology as Research Field and Therapeutic Medium. W. Holzer. *E.u.M.* 54. *pp.* 157–161, *April* 5, 1936.—Considers three types of electro-medical treatment, (1) nerve physiology, (2) electrocardiography, (3) short-wave therapy (diathermy). As examples of research into the first is instanced applications of the kathode-ray oscillograph to the study of currents and other stimuli in nerves, while much work is required into the wave-form of the current recorded by the electrocardiograph. Diathermy involves researches into the dielectric losses and h.f. resistances of organic materials. G. E. B.

2894. Possibility of Local Heating in H.F. Condenser Field. N. Malow. *Phys. Zeits. d. Sowjetunion*, 9. 2–3. *pp.* 271–272, 1936. *In German.*—Krasny-Ergen has obtained a formula [see Abstract 4009 (1935)], $t_2 \leqslant WR^2/3\Lambda$, where W is the energy input, Λ the heat conductivity and R the radius, for the temperature of a sphere placed in a h.f. field. This suggests that local heating will take place when small bodies such as bacteria are subjected to the field. It is pointed out, however, that this formula does not hold for small values of R. A new formula is suggested for such cases: $t \gg 3E_a^2\omega^2\sigma^2_i R^2/\lambda_a\,[16\pi^2\sigma^2_i + \omega^2(2 + \epsilon_i)^2]$, where E_a is the field strength, ω is the frequency, λ_a the heat conductivity of air, σ_i and ϵ_i the electrical conductivity and dielectric constant respectively of the sphere. Experiments with Drosophila show that this formula is substantially correct. In the case of the human body it is suggested that the formation of colonies of bacteria with a reduction in heat loss, may result in some local heating. J. E. R.

2895. Diagnostic Radiographs. W. Watson. *Radiography*, 2. *pp.* 49–55, *April*, 1936.—Discusses the form of the characteristic curve of an emulsion and the influence of an intensifying screen on its shape. The gradation of the film is approximately logarithmic, and several parts of the body are of such opacity ratios that this is a distinct advantage. Certain factors concerning the advisability of using screens in special cases are discussed in some detail. G. E. B.

***2896. Modern H.V. Equipment. S. Gradstein.** *Philips Techn. Rev.* 1. *pp.* 6–10, *Jan.*, 1936.—The equipment furnishes peak voltages up to 1000 kV, and a d.c. voltage of 700 kV, a current of 4 mA being derived. Compactness and simplicity of control are its features. It is composed of two symmetrical units. One unit comprises 4 stages, each consisting of a condenser and valve; each structural element is subject to $\frac{1}{8}$ of the total voltage. The valves are designed to cope with a 200-kV backfiring voltage. The oxide kathodes are heated by means of a h.f. generator. [See also Abstract 2215 (1934).] AUTHOR.

2897. Effect of Air Temperature, Pressure and Humidity on Ionisation Measurements. A. Quinton. *Brit. J. of Radiology*, 9. *pp.* 313–323, *May*, 1936.—The ionisation current, measured in a condenser chamber of air-wall material, is shown to be directly proportional to the density of the air inside the chamber. The method of reducing ionisation measurements to standard conditions is described and, in particular, it is found that the humidity of the air affects ionisation measurements to an extent of 1 % and should therefore be corrected for in accurate or absolute measurements. There does not seem to be any justification for disregarding humidity in the definition of the röntgen. In general, the expansion of the chamber may be neglected in comparing ionisation measurements made at different temperatures, but graphited-celluloid chambers form an exception. The advantages of defining the röntgen in terms of the mass of the air instead of the volume are indicated. AUTHOR.

***2898. Prevention of Radiation Injuries in Handling Mesothorium and Radium. W. Friedrich and W. Noethling.** *V.D.I.* 80. *pp.* 437–440, *April* 11, 1936.—The dangers attendant on the handling of radioactive materials emitting γ-rays are discussed and suggestions are made for minimising them. It is recommended that full use be made of the protection afforded by distance and by lead filters. A suitably protected working bench is described, together with carriers for large and small quantities of Ra. Tables are given of what are regarded as safe working distances from quantities of Ra from 10 to 5000 mg. under various conditions of filtration. A short account is given of the biological effects of exposure to low intensity γ-radiation. J. E. R.

2899. Radiosensitivity in Relation to Time-Intensity Factor. R. McWhirter. *Brit. J. of Radiology*, 9. *pp.* 287–299, *May*, 1936.—The economic and scientific aspects of the controversy which has arisen regarding the merits of high and low dosage rates in the treatment of malignant disease by γ-rays and X-rays, are briefly discussed. A series of experiments is described in which normal skin is treated with γ-rays, in some cases with a low dosage rate of 12 *r*/hour and in others with dosage rates up to 1200 *r*/hour. No recognisable difference was found between the results of high and low dosages rates. In the same way a series of 24 cases (22 of malignant disease) were treated, some with high and some with low dosage rates, the total dose being the minimum lethal dose for the type of tumour treated. The results indicate that the low intensity methods have no biological superiority over high intensity methods. It is suggested that if more marked erythema results in any cases, from the use of high dosage rates, the possibility of greater tumour damage should not be overlooked. A short series of X-ray experiments on erythema production leads to the same conclusions. J. E. R.

See also Abstracts 2509, 2694, 2872.

OSCILLATIONS AND WAVES.

***2900. Limit of Charge Sensitivity of the Valve Electrometer. Part II. H. Alfvén.** *Zeits. f. Physik*, 99. 9–10. *pp.* 714–716, 1936.—The author gives a more accurate theoretical discussion than before [see Abstract 2427 (1936)] of the factors limiting the charge sensitivity of a valve amplifier used as an electrometer. Methods are suggested whereby it should be possible to measure experimentally the shot effect independently of the thermal fluctuations. L. A. W.

***2901. Voltage Sources and Amplifiers for Geiger Counters. N. S. Gingrich.** *Rev. Sci. Instruments*, 7. *pp.* 207–210, *May*, 1936.—A modified pentode stabiliser is described in which a neon lamp replaces the usual battery for maintaining a constant grid bias. This circuit stabilises the voltage as well as that with a battery, and is much more flexible. A simple stabiliser is described in which a bank of neon lamps supplies the stabilised voltage directly. A new amplifier, using two standard radio valves and a small neon lamp is described. A brief report is made of the use of a "Strobotron" in counter circuits. AUTHOR.

***2902. Null-Method for Measurement of Audio Frequencies. K. Karandejew.** *Techn. Phys., U.S.S.R.* 8. 1. *pp.* 51–64, 1936. *In German.*—Current of the frequency to be measured is passed through a non-inductive resistor, and a condenser (or inductance) in parallel. A thermojunction is included in each branch of the circuit and the p.d.'s developed at the two junctions are balanced by means of a potentiometer device, the setting of which at balance is a function of the frequency. The arrangement may therefore be calibrated in terms of frequency. L. H.

2903. Operational Proof of the Wave Potential Theorem, with Applications to Electromagnetic and Acoustic Systems. S. Ballantine. *Frank. Inst., J.* 221. *pp.* 469–484, *April,* 1936.—By the use of the operational method a simple deduction of the integral solution of the wave equation is obtained. The application of this result to the solution of the electromagnetic wave equations is described and various special cases are considered. The theorem is also applied to acoustical matters, the sound radiation from a surface source and a double surface source being calculated. It is pointed out that the solutions given by Rayleigh for these sources have been frequently misused in the literature of the subject, several examples of this being quoted. J. E. R. C.

2904. Ionospheric Electron Temperatures and the Hals-Störmer Echo. J. Fuchs. *Gerlands Beitr. z. Geophys.* 47. 1–2. *pp.* 1–14, 1936.—Examination of the influence of the free electrons in the various layers of the ionosphere shows that at the times of high activity of the sun the electron temperature may reach values as high as 40,000° and change fundamentally the distribution of electrons by influencing their rate of recombination. On the basis of these views the Hals-Störmer echo presents itself as a phenomenon of extreme conditions which arises mainly at times of strong u.v. radiation of the sun (sunspot maximum) only. A discussion is given of the physical effects in the ionosphere connected with these facts. [See also Abstract 2994 (1935).] A. W.

2905. Recording Ionospheric Echoes at the Transmitter. R. R. Bajpai. *Nat. Acad. Sci. India, Proc.* 6. *pp.* 40–48, *Feb.,* 1936.—A simple 4Mc/sec. transmitter arranged to give pulses is connected to a half-wave horizontal dipole placed approximately N. and S. The receiver for operating the kathode-ray tube is inductively coupled to the same aerial system. The whole is synchronised by injecting a small voltage from a 50 ∼ source. The equipment was set up at Allahabad, India, and the paper gives an account of the results obtained between Dec., 1934, and Feb., 1935. Echoes from the F-layer were almost always recorded and occasionally some were observed from the E-region. Investigations carried during the course of a lunar eclipse seemed to show a definite lunar effect on the ionosphere. [See following Abstract.] F. S. B.

2906. Ionospheric Height at Allahabad. T. D. Bansal. *Techn. Phys., U.S.S.R.* 3. 2. *pp.* 111–134, 1936. *In English.*—This deals with the same investigation [see preceding Abstract], but the results are recorded in more detail and largely in graphical form. A Bibliography of over 40 references is given at the end of the paper. F. S. B.

2907. Accurate Determination of Ionospheric Heights. E. C. Halliday. *Phys. Soc., Proc.* 48. *pp.* 421–432, *May* 1, 1936.—In order to increase the accuracy with which ionospheric heights may be determined by the pulse method it was decided to increase the effective length of the time-base scale on the kathode-ray oscillograph. This was done by disposing successive short lengths of it one below the other, a modification of a television time-base due to Bedford and Puckle being used for the purpose. Using the first differential of the pulse voltage to obtain the position of the peak improves somewhat further the effective accuracy so that in the final result height separations of the order of 5 km. can be made with considerable accuracy. Using this equipment a discontinuity in the height-frequency curve is shown to exist at 2 Mc/sec. This phenomenon first observed by Naismith has all the characteristic of penetration suggesting that there is a secondary maximum of ionisation a few km. below the maximum of the E-region similar to the ledge of the F-region discovered by Appleton. F. S. B.

2908. Polarisation of Radio Waves from the Ionosphere near the Geomagnetic Equator. H. W. Wells and L. V. Berkner. *Terr. Mag.* 41. *pp.* 75–82, *March*, 1936.—Theory predicts that in the special case of propagation of a wave in the ionosphere with its wave-normal perpendicular to the earth's magnetic field at all points of the wave-path the two wave components returned should be plane polarised in mutually perpendicular planes. Polarisation experiments have been conducted from the Huancayo Magnetic Observatory (Peru) 2° 10′ from the geomagnetic equator in order to check this theory. The two components are found as predicted with the electric vector of the ordinary wave-component plane polarised in the magnetic north-south plane and the extraordinary component in the magnetic east-west plane. The reduction of the refractive index of the medium for any given number of charges is found to be greater for the extraordinary wave-component. F. S. B.

See also Abstracts 2720, 2842.

PHOTOELECTRICITY.

2909. Photoelectric Properties of Sodium Films on Aluminium. J. J. Brady and V. P. Jacobsmeyer. *Phys. Rev.* 49. *pp.* 670–675, *May* 1, 1936.—The maximum sensitivity of Na films deposited on Al is not attained before the film thickness reaches 80 molecular layers; it then remains constant for greater thicknesses. No detectable photo-current is observed for less than 5 molecular layers. Spectral distribution curves, analysed according to Fowler's theory, yield a value of 5150 Å for the threshold of the Na film, and this is the same for all thicknesses of film. Current-voltage curves for different thicknesses of film, analysed according to Du Bridge's theory, indicate that the work function of the various films is the same, the value for the freshly distilled Al on which the deposits were made being 4·08 volts, which gives a value of 3020 Å for the threshold of Al. The photoelectric current decreases immediately after forming a film, but the decrease is much less for films greater than 50 molecular layers. It is suggested that this decrease results from the surface migration of the Na atoms in forming aggregates. [See also Abstract 401 (1933).] N. M. B.

2910. Photoelectric Effect at Thin Layers of Aluminium and Tantalum Oxides. G. Rosenthal. *Zeits. f. Physik,* 99. 9–10. *pp.* 607–621, 1936.—A photoelectric effect is observed at electrolytically formed oxide layers on Al and Ta anodes. Measurements are made with the electrode in the electrolyte and with different applied voltages, the illumination being with u.v. light through the liquid. The photoelectric effect is greater for Ta than for Al, both absolutely and relatively to the residual dark current upon which it is superimposed. The data obtained are insufficient for an explanation of the mechanism of the effect. L. A. W.

2911. Spectral Distribution of the Current of Depolarisation in KCl Crystals Treated with X-Rays. N. Kalabuchow and I. Kurschew. *Zeits. f. Physik*, 99. 3–4. *pp.* 254–258, 1936.—The curve of the spectral distribution of the depolarisation current in KCl crystals subjected to X-rays is measured. It is shown that the curve has two maxima, at 570 and 630 mμ. Based on the observed results considerations on the energy levels of the electrons in KCl are given. [See also Abstract 921 (1935).] J. J. S.

See also Abstract 2698.

PIEZOELECTRICITY.

2912. Sound Production by Piezoelectric Quartz. A. de Gramont and D. Beretzki. *Comptes Rendus*, 202. *pp.* 1229–1232, *April* 6, 1936.—It is shown that sound waves of frequencies from 50 to 30,000 $\sim$ can be emitted by a quartz crystal designed so as to vibrate in flexion. This is achieved by cutting two rectangular laminæ perpendicular to the electric axis, sticking them together either with their electric axes antiparallel and the outer faces silvered to act as electrodes; or with electric axes parallel, the interface being one electrode, and the two connected outer faces the other. The usefulness of the device in transforming acoustic or mechanical energy into electrical, and *vice versa*, as in microphones, vibrographs, etc., is pointed out. K. M. C.

2913. Vibration Equations of Piezoelectric Quartz. B. van Dijl. *Physica*, 3. *pp.* 317–326, *May*, 1936. *In English.*—It is shown that the application of Ricci-calculus to the elastic vibration and piezoelectric equations yields results, which can be readily interpreted. The wave equation is derived from the general equation of motion. The equations are worked out for Y-cut (30°-cut) plates and for Yθ-cut plates. In particular the so-called AC-cut plate is examined. AUTHOR.

THERMIONICS.

2914. Conjugate Potential Functions and the Problem of the Finite Grid. W. H. Barkas. *Phys. Rev.* 49. *pp.* 627–630, *April* 15, 1936.—A general expression is set up giving the conformal transformation for any assigned two-dimensional charge distribution. By evaluating certain sums the conjugate functions for a grid of K elements are found. The transformation for such a grating when placed parallel to an infinite plane is also computed. AUTHOR.

2915. Theory of the Work Function. Part II. Surface Double Layer. J. Bardeen. *Phys. Rev.* 49. *pp.* 653–663, *May* 1, 1936.—The work function of a monovalent metal [see Abstract 3701 (1935)] includes an energy term due to the movement of an electron through an electrostatic double layer at the surface. To determine the moment of this double layer the electrons are considered to be so distributed inside the metal that they neutralise the positive charge density, making the metal as a whole neutral. An approximate self consistent solution of Fock's equations gives the charge density at the surface. The effects of polarisation forces on the double layer are introduced and the final values of work functions are 2·35 eV and 2·00 eV and of the moment of the double layer 0·4 eV and 1·00 eV, the latter values including the polarisation forces. The results are compared with experimental values of Na and the conclusion is drawn that polarisation forces outweigh greatly electrostatic forces. H. M. B.

2916. Constant A in Richardson's Equation. E. Wigner. *Phys. Rev.* 49. *pp.* 696–700, *May* 1, 1936.—According to Herzfeld, the "chemical constant" of the electron gas is different in the high temperature region, where all actual measurements are carried out, from its value at very low temperatures. Hence the value of the constant A in Richardson's equation must be different at high temperatures from the well-known low temperature value of 120 A/cm². °K². The present paper gives a calculation of the high temperature value in terms of thermodynamic quantities and a numerical estimation of these. AUTHOR.

2917. Measurement of Secondary-Electron Emission from Filaments. L. R. G. Treloar. *Phys. Soc. Proc.* 48. *pp.* 488–496; *Disc.*, 497, *May* 1, 1936.—A method of measuring secondary emission which may have advantages over the usual methods in certain cases is described. The source of electrons is a W filament mounted axially in a cylindrical grid and anode. The filamentary target is placed parallel to the kathode. With the grid connected to the kathode there is a considerable range of positive potentials V_t and V_a on target and anode respectively for which no secondaries can pass through the grid; under these conditions it is shown both theoretically and practically that the target current i_t is proportional to $\sqrt{(V_t/V_a)}$. This law is then used to determine the primary currents for high values of V_a such that all secondaries emitted from the target reach the anode. These, together with the measured values of i_t, give the secondary emission. The possible effects of high velocity secondaries are considered. Application of the method to W and Ta gives results in agreement with published data. AUTHOR.

2918. Oxide Kathodes of Colloidal Structure. E. Patai and Z. Tomaschek. *Kolloid Zeits.* 75. *pp.* 80–88, *April*, 1936.—A disadvantage of Buzágh's colloids for the production of oxide kathodes is the long time required for the cataphoretic deposition of the layer. It has, however, been found that the deposition time can be considerably reduced if methyl alcohol is used as the means of dispersion. Still further reduction has been obtained by the use of glycerin or glycol. With the new glycerin or glycol methods it is found easily possible to produce colloidal layers of $BaCO_3$ and $SrCO_3$ mixed crystals. The paper concludes with an account of sedimentation measurements and a series of microphotographs. [See Abstract 2462 (1936).] A. W.

See also Abstracts 2867, 2872.

THERMOELECTRICITY.

***2919. Mathematical Theory of the Thermoelectric Couple. A. Tichonov.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 4–5. *pp.* 177–183, 1935. *In French.*—The author examines mathematically the measurement of the temperature at a point, by means of a thermoelectric couple, taking into account the fact that the introduction of measuring apparatus into the field of observation produces a modification of that field. J. J. S.

2920. Thermo-E.M.F.s of Ni-Cu and Fe-Cu by the Twin-Galvanometer Method. E. Rosenbohm and F. M. Jaeger. *K. Akad. Amsterdam, Proc.* 39. 4. *pp.* 469–477, *April*, 1936.—A point occurs in the thermo-e.m.f./temperature curve at 903° C. on heating, and at 865° C. on cooling, for the Fe-Cu couple. The Ni-Cu couple gives a fairly smooth curve from 300° C. to 400° C., above this the e.m.f. drops to less than half its previous value. [See Abstract 2287 (1936).] D. R. H.

See also Abstract 2773.